

A 94 52
IIA17



United States
Environmental Protection
Agency

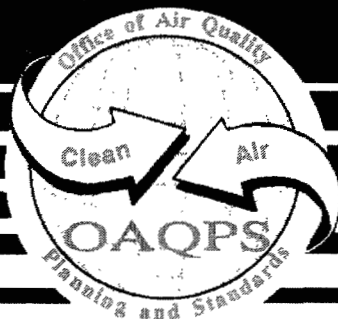
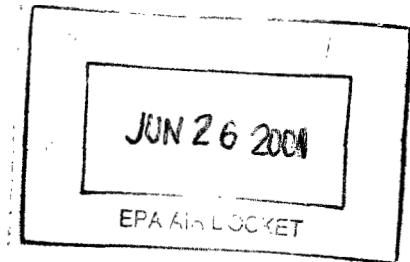
Office Of Air Quality
Planning And Standards
Research Triangle Park, NC 27711

EPA-452/R-00-007
May 2001
FINAL REPORT

Air

Economic Impact Analysis of Proposed Reinforced Plastics NESHAP

Final Report



Economic Impact Analysis of Proposed Reinforced Plastics NESHAP

**U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Innovative Strategies and Economics Group, MD-15
Research Triangle Park, NC 27711**

Prepared Under Contract By:

**Research Triangle Institute
Center for Economics Research
Research Triangle Park, NC 27711**

May 2001

This report has been reviewed by the Emission Standards Division of the Office of Air Quality Planning and Standards of the United States Environmental Protection Agency and approved for publication. Mention of trade names or commercial products is not intended to constitute endorsement or recommendation for use. Copies of this report are available through the Library Services (MD-35), U.S. Environmental Protection Agency, Research Triangle Park, NC 27711, or from the National Technical Information Services 5285 Port Royal Road, Springfield, VA 22161.

CONTENTS

| <u>Section</u> | <u>Page</u> |
|---|-------------|
| 1 Introduction | 1-1 |
| 1.1 Organization of the Report | 1-1 |
| 2 Industry Profile | 2-1 |
| 2.1 Production | 2-3 |
| 2.1.1 Material Inputs | 2-5 |
| 2.1.1.1 Plastic Resins | 2-5 |
| 2.1.1.2 Reinforcements | 2-6 |
| 2.1.1.3 Nonreinforcing Fillers | 2-8 |
| 2.1.1.4 Additives | 2-9 |
| 2.1.2 Production Processes | 2-10 |
| 2.1.2.1 Open Molding Processes | 2-11 |
| 2.1.2.2 Closed Molding Processes | 2-15 |
| 2.2 Products | 2-20 |
| 2.3 Cost of Production | 2-20 |
| 2.4 Uses and Consumers of Reinforced Plastics | 2-22 |
| 2.5 Manufacturing Facilities | 2-29 |
| 2.5.1 Location | 2-31 |
| 2.5.2 Employment | 2-31 |
| 2.6 Facility Ownership | 2-31 |
| 2.6.1 Size Distribution | 2-33 |
| 2.6.2 Issues of Vertical and Horizontal Integration | 2-33 |
| 2.7 Small Businesses | 2-36 |
| 2.7.1 Identifying Small Businesses | 2-36 |

| | | |
|---------|---|------|
| 3 | Engineering Costs | 3-1 |
| 3.1 | Identifying Regulated Entities | 3-1 |
| 3.2 | National Control Cost Estimates | 3-1 |
| 4 | Economic Impact Analysis | 4-1 |
| 4.1 | Reinforced Plastic Composite Markets | 4-2 |
| 4.2 | Producers, Costs, and Supply | 4-6 |
| 4.3 | Consumers, Value, and Demand | 4-8 |
| 4.4 | Baseline and With-Regulation Equilibrium | 4-10 |
| 4.5 | Results | 4-10 |
| 4.5.1 | Market-Level Impacts | 4-12 |
| 4.5.2 | Industry-Level Impacts | 4-16 |
| 4.5.2.1 | Changes in Operating Profit | 4-16 |
| 4.5.2.2 | Product-Line and Facility-Level Impacts | 4-20 |
| 4.5.2.3 | Changes in Employment | 4-21 |
| 4.6 | Social Costs | 4-21 |
| 4.7 | Sensitivity Analysis for Profit Rate | 4-25 |
| 4.8 | New Source Analysis | 4-26 |
| 5 | Initial Regulatory Flexibility Analysis | 5-1 |
| 5.1 | Identifying Small Businesses | 5-2 |
| 5.2 | Screening-Level Analysis | 5-2 |
| 5.2.1 | Recommended Alternative | 5-3 |
| 5.2.2 | MACT Floor Alternative | 5-6 |
| 5.2.3 | Above-the-MACT Floor Alternative | 5-6 |
| 5.3 | Economic Analysis | 5-6 |
| 5.4 | Assessment | 5-12 |
| 5.5 | Projected Reporting and Recordkeeping Requirements | 5-13 |
| 5.6 | Other Federal Rules That May Impact Reinforced Plastic Composite Production Facilities | 5-14 |

| | | |
|------------|---|------|
| 5.7 | Alternatives to the Proposed Rule | 5-14 |
| References | | R-1 |
| Appendix A | Summary Data for Companies Owning Reinforced Plastic Composite Facilities | A-1 |
| Appendix B | Economic Model of the Merchant Sector of the U.S. Reinforced Plastic Composites Industry | B-1 |

LIST OF FIGURES

| <u>Number</u> | | <u>Page</u> |
|---------------|--|-------------|
| 2-1 | Production Flows for Reinforced Plastic Composites | 2-4 |
| 2-2 | Hand Lay-up Processing | 2-12 |
| 2-3 | Spray-up Processing | 2-13 |
| 2-4 | Filament Winding | 2-14 |
| 2-5 | Pultrusion | 2-16 |
| 2-6 | Injection Molding | 2-19 |
| 2-7 | Consumption of Reinforced Plastic Composites by Market Segment: 1997 | 2-27 |
| 2-8 | Geographic Distribution of Major Source Facilities | 2-32 |
| 2-9 | Alternative Chains of Ownership | 2-34 |
| 2-10 | RPC Firms by Size | 2-37 |
| 4-1 | Supply Curve for a Representative Directly Affected Merchant Facility | 4-7 |
| 4-2 | Demand Curve for RPCs | 4-9 |
| 4-3 | Market Equilibrium Without and With Regulation | 4-11 |
| 4-4 | Sensitivity of Changes in Consumer Surplus to the Elasticity of Demand | 4-25 |
| 4-5 | Baseline Equilibrium without Regulation | 4-27 |
| 4-6 | With-Regulation Equilibrium Case 1: New Sources Added | 4-29 |
| 4-7 | With-Regulation Equilibrium Case 2: No New Sources Added | 4-29 |
| 5-1(a) | Distribution of Cost-to-Sales Ratios for Small Companies: Recommended Alternative | 5-5 |
| 5-1(b) | Distribution of Cost-to-Sales Ratios for Large Companies: Recommended Alternative | 5-5 |
| 5-2(a) | Distribution of Cost-to-Sales Ratios for Small Companies: MACT Floor Alternative | 5-8 |
| 5-2(b) | Distribution of Cost-to-Sales Ratios for Large Companies: MACT Floor Alternative | 5-8 |
| 5-3(a) | Distribution of Cost-to-Sales Ratios for Small Companies: Above-the- MACT-Floor Alternative | 5-10 |

| | |
|---|------|
| 5-3(b) Distribution of Cost-to-Sales Ratios for Large Companies: Above-the- MACT-Floor Alternative | 5-10 |
|---|------|

LIST OF TABLES

| <u>Number</u> | | <u>Page</u> |
|---------------|---|-------------|
| 2-1 | SIC Codes for Potentially Affected Products | 2-2 |
| 2-2 | Consumption of Reinforced Plastics by Resin Type: 1991-1993 | 2-7 |
| 2-3 | Consumption of Fibrous Reinforcements in Plastics: 1990 | 2-8 |
| 2-4 | Consumption of Nonreinforcing Fillers in Plastics: 1990 | 2-9 |
| 2-5 | Consumption of Plastics Additives: 1990 | 2-10 |
| 2-6 | Reinforced Plastics Shipments by Production Process: 1990 | 2-11 |
| 2-7 | Compatibility of RPC Production Processes with Shape Characteristics and Specific Products | 2-21 |
| 2-8 | Plastic Resin Prices: 1996-1999 | 2-23 |
| 2-9 | Selected Plastic Reinforcement and Filler Prices: 1997 | 2-24 |
| 2-10 | Demand for Reinforced Plastic Composites: Some Examples | 2-26 |
| 2-11 | Consumption of Reinforced Plastic Composites by End Use: 1984- 1997 (10 ⁶ lbs) | 2-28 |
| 2-12 | Consumption of Reinforced Unsaturated Polyester by End Use: 1984- 1993 (10 ⁶ lbs) | 2-30 |
| 2-13 | Distribution of Major Source Facilities by Employment | 2-33 |
| 2-14 | Distribution of Potentially Affected Firms by Employment | 2-35 |
| 2-15 | Distribution of Potentially Affected Firms By Sales | 2-35 |
| 2-16 | Small Business Administration Size Standards for RPC—Companies by SIC | 2-38 |
| 4-1 | Reinforced Plastics Composites Shipments by End-Use Market: 1997 (10 ⁶ lbs) | 4-4 |
| 4-2 | Estimated Market Quantities and Prices for Reinforced Plastics Composites by Product Group: 1997 | 4-5 |
| 4-3 | Market-Level Impacts of the Reinforced Plastic Composites NESHAP Regulatory Alternatives: 1997 | 4-13 |
| 4-4 | Summary of Compliance Costs and Market Price Changes: 1997 (\$/lb) | 4-15 |
| 4-5 | Industry-Level Impacts of Reinforced Plastic Composites NESHAP Regulatory Alternatives: 1997 | 4-17 |

| | | |
|------|---|------|
| 4-6 | Distributional Impacts on Merchant Thermoset Producers Associated with Reinforced Plastic Composites NESHAP Regulatory Alternatives: 1997 | 4-19 |
| 4-7 | Social Costs with Reinforced Plastic Composites NESHAP Regulatory Alternatives: 1997 | 4-23 |
| 4-8 | Summary of Economic Impacts Under Range of Industry Profit Rates: Recommended Alternative | 4-27 |
| 4-9 | New Source Analysis of Unit Production and Compliance Costs (\$1997) | 4-30 |
| 4-10 | Changes in Facility Construction Under the Proposed NESHAP: 2000–2005 | 4-32 |
| 5-1 | Summary Statistics for SBREFA Screening Analysis: Recommended Alternative | 5-4 |
| 5-2 | Summary Statistics for SBREFA Screening Analysis: MACT Floor Alternative | 5-7 |
| 5-3 | Summary Statistics for SBREFA Screening Analysis: Above-the-MACT-Floor Alternative | 5-9 |
| 5-4 | Summary of Small Business Impacts of Reinforced Plastic Composites NESHAP | 5-11 |

SECTION 1

INTRODUCTION

The Clean Air Act's (CAA's) purpose is to protect and enhance the quality of the nation's air resources (Section 101(b)). Under the authority of Section 112 of the CAA as amended in 1990, the U.S. Environmental Protection Agency (EPA or the Agency) is currently developing a National Emission Standard for Hazardous Air Pollutants (NESHAP) to reduce emissions generated during the production of reinforced plastic composites (RPCs). This report evaluates the economic impacts of three regulatory alternatives that are designed to control these releases.

1.1 Organization of the Report

This report is divided into four sections and two appendices that describe the industry and economic methodology and present results of this economic impact analysis (EIA):

- Section 2 provides a summary profile for the manufacture of RPCs. It presents data on manufacturing plants and the companies that own and operate these plants.
- Section 3 reviews the regulatory control alternatives and associated costs of compliance. This section will be included in the final EIA and will be based on EPA's engineering analysis conducted in support of the proposed NESHAP as described in the Background Information Document (BID).
- Section 4 details the methodology for assessing the economic impacts of the proposed NESHAP and the results of the analysis, which include market, industry, and social welfare impacts.
- Section 5 provides the Agency's screening and economic analyses of the regulation's impact on affected small businesses.
- Appendix A provides a list of companies that own directly affected facilities and includes sales, employment, and size classification.
- Appendix B provides a detailed description of the Agency's economic model.

SECTION 2

INDUSTRY PROFILE

Plastics are one of the most used materials in U.S. industrial and commercial activities and contribute to virtually all products consumed from packaging to motor vehicles. Plastics can be divided into two major groups by resin type: thermoset or thermoplastic. When additional strength is required, many plastics can be reinforced with structural materials to produce RPCs.

In the production of RPCs, polymers and reinforcing materials can be compounded with a variety of fillers to minimize resin requirements and additives that change the physical properties of the desired composite. The polymer is most often a thermosetting resin and the typical reinforcement is glass fiber. Compounding consists of mixing these various materials (sometimes in several stages) and reforming the homogeneous mass into a usable form such as pellets, flakes, or sheets for processing into the final product. A wide variety of RPC processes have evolved to facilitate efficient production of many different types of composites with different physical properties. The fundamental characteristics of the resulting composites include lightweight, high strength-to-weight ratio, nonconductivity, various degrees of corrosion-resistance, and dimensional stability.

In 1997, 3.4 billion pounds of RPCs were consumed in the United States. The RPC market is divided into a number of segments according to its end use. The market segments include general aviation, aerospace, appliances, business equipment, construction, consumer goods, corrosion-resistant products, electrical/electronics, marine, and land transportation (e.g., motor vehicles, trucks, buses). The transportation segment was the largest consumer of RPCs with 1,095 million pounds, or 32 percent of the total consumed in 1997. The construction segment followed with 700 million pounds of reinforced plastics consumed in 1997 (SPI, 1998).

Reinforced plastics are used in the production of many different products, as indicated by the involvement of 42 different SIC codes, as Table 2-1 shows. The SIC codes were

Table 2-1. SIC Codes for Potentially Affected Products

| SIC | Definition |
|------|---|
| 2434 | Wood Kitchen Cabinets |
| 2519 | Household Furniture, NEC |
| 2522 | Office Furniture, Except Wood |
| 2541 | Wood Office and Store Fixtures, Partitions, Shelving, and Lockers |
| 2599 | Furniture and Fixtures, NEC |
| 2821 | Plastics Material and Synthetic Resins, and Nonvulcanizable Elastomers |
| 3082 | Unsupported Plastics Profile Shapes |
| 3083 | Laminated Plastics Plate, Sheet, and Profile Shapes |
| 3084 | Plastics Pipe |
| 3087 | Custom Compounding of Purchased Plastics Resins |
| 3088 | Plastics Plumbing Fixtures |
| 3089 | Plastics Products, NEC |
| 3281 | Cut Stone and Stone Products |
| 3296 | Mineral Wool |
| 3299 | Nonmetallic Mineral Products, NEC |
| 3431 | Enameled Iron and Metal Sanitary Ware |
| 3499 | Fabricated Metal Products, NEC |
| 3531 | Construction Machinery and Equipment |
| 3533 | Oil and Gas Field Machinery and Equipment |
| 3546 | Power-Driven Handtools |
| 3561 | Pumps and Pumping Equipment |
| 3564 | Industrial and Commercial Fans and Blowers and Air Purification Equipment |
| 3589 | Service Industry Machinery, NEC |
| 3612 | Power, Distribution, and Specialty Transformers |
| 3613 | Switchgear and Switchboard Apparatus |
| 3621 | Motors and Generators |
| 3647 | Vehicular Lighting Equipment |
| 3663 | Radio and Television Broadcasting and Communications Equipment |
| 3679 | Electronic Components, NEC |
| 3711 | Motor Vehicles and Passenger Car Bodies |
| 3713 | Truck and Bus Bodies |
| 3714 | Motor Vehicle Parts and Accessories |
| 3715 | Truck Trailers |
| 3716 | Motor Homes |
| 3728 | Aircraft |
| 3743 | Aircraft Parts and Equipment, NEC |
| 3792 | Travel Trailers and Campers |
| 3799 | Transportation Equipment, NEC |
| 3821 | Laboratory Apparatus and Furniture |
| 3949 | Sporting and Athletic Goods, NEC |
| 3993 | Signs and Advertising Specialties |
| 3999 | Manufacturing Industries, NEC |

obtained from the updated 1993 EPA survey and subsequent screening for potentially affected reinforced plastics producers.

The remainder of this section provides a brief introduction to the reinforced plastics industry. Although the reinforced plastics source category includes only thermoset materials, this profile provides a broader picture of the RPC industry. Section 2.1 provides an overview of the RPC production processes, including a description of the major inputs to production and directly affected production processes. Section 2.2 characterizes the resulting reinforced plastics products and presents historical data on their consumption across various end uses. Section 2.3 details the costs of production. Section 2.4 describes uses and consumers of reinforced plastics. Section 2.5 summarizes U.S. production facilities, and Section 2.6 describes the firms that own these facilities.

2.1 Production

The basic stages of production for RPCs are compounding and processing, as Figure 2-1 illustrates. Polymers and reinforcing materials are compounded with a variety of fillers to minimize resin requirements and additives that change the physical properties of the desired composite. The polymer is most often a thermosetting resin such as polyester (unsaturated), vinyl ester, phenolic, or epoxy; however, thermoplastic resins such as nylons and polyolefins are increasingly being utilized. Compounding consists of mixing these various materials (sometimes in several stages) and then reforming the homogeneous mass into a usable form such as pellets, flakes, or sheets for processing into the final product.

Processing involves shaping and/or molding the compounded plastic material into the desired final product. A wide variety of RPC processes have evolved to facilitate efficient production of many different types of composites with different physical properties. RPC production processes can be separated into two broad categories: open molding and closed molding. Open molding refers to processes where the plastic resins, polymers, reinforcements, and other additives are exposed to the air during the shaping and/or curing stages of processing. This category includes such manual contact molding processes as hand lay-up and spray-up, as well as processes with a greater degree of automation, such as centrifugal casting, filament winding, pultrusion, and continuous lamination. Closed molding processes isolate the input materials inside closed molds during the mixing and curing stages. These include more capital-intensive production methods such as match die molding, reaction injection molding, rotational molding, and thermoforming.

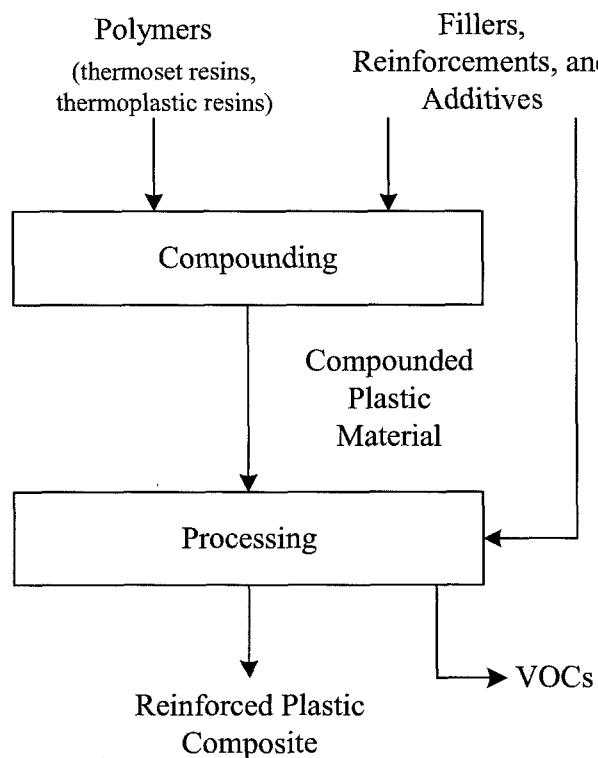


Figure 2-1. Production Flows for Reinforced Plastic Composites

Pollution releases can occur throughout the production processes. Spills of additives and plastic pellets can occur during transport to the facility. Leaks of chemical additives can occur while the additives are being incorporated into the plastic. Volatile organic compounds (VOCs), fugitive emissions, and wastewater discharge are released during the actual processing of the reinforced plastic part. The finishing operations of cleaning can also release VOCs, fugitive emissions, and wastewater discharge (EPA, 1995).

The result of the processing stage is the final part or product referred to as a RPC. RPCs range from small parts for toys or automotive uses to composite structures such as boat hulls, automobile panels, or the fuselage of an aircraft. Thus, some RPCs constitute a final product such as a bathtub or shower stall, whereas others are intermediate products such as

panels, pipes, and molding compounds that serve as inputs to manufacturing processes and construction activities.

The remainder of this section describes the manufacture of RPCs in terms of the input materials used, the production processes employed, and the types of products ultimately produced.

2.1.1 Material Inputs

This section describes the different types of plastic resins, reinforcements, fillers, and additives that are most commonly used in the production of RPCs. It includes a discussion of both thermoset and thermoplastic materials; however, EPA's RPC source category only includes thermoset materials.

2.1.1.1 Plastic Resins

There are two broad categories of plastic resins: thermoplastics and thermosets. Thermoplastic resins become soft when heated and may be shaped or molded while in a heated semi-fluid state. Once the thermoplastic resin is molded to the proper state, it is cooled until hardened. In contrast, thermoset resins are usually liquids or low melting point solids in their initial form. When used to produce finished goods, these thermosetting resins are "cured" by the use of a catalyst, heat, or a combination of the two. Once cured, thermoset resins cannot be converted back to their original liquid form. Unlike thermoplastic resins, cured thermosets will not melt and flow when heated and once formed they cannot be reshaped.

Thermoplastics have certain advantages as substitutes for thermoset resins. Thermoplastics have faster processing than thermosets because there is no curing necessary; they have low toxicity and can be remelted and recycled. Improvements in thermoplastic resins over the past 20 years have increased the advantages over thermoset resins. Thermoplastics have high delamination, chemical, and damage resistance, and low moisture absorption (Berglund, 1998). The damage resistance of thermoplastics is due to high impact strength and fracture resistance. Thermosets have better resistance to matrix microcracking in the composite laminate, while thermoplastics have higher strains to failure (Schwartz, 1997). Differences in the characteristics and strengths between thermosets and thermoplastics lead to less than perfect substitution and a gradual increase in the use of thermoplastics for reinforced plastics. Thermoplastics' share of all resins used for reinforced plastics increased by 1 percent from 1991 to 1993.

From 1991 to 1993, thermoset and thermoplastic use for reinforced plastics increased, with thermosets accounting for consistently more than twice the quantity of thermoplastics, as Table 2-2 shows. These figures include the weight of resins, reinforcements, and fillers. Thermoset unsaturated polyesters accounted for roughly 60 percent of the total reinforced plastics shipped during each of these years. Other thermosets, mainly epoxies and phenolics, accounted for an additional 7 to 10 percent of total usage. Recent innovations in thermoplastic resin formulation have improved both their performance properties and cost-effectiveness to the point that their use for RPC production is increasing. Thermoplastics are widely used because of their ability to model complex shapes, their ease of fabrication, and their cost-effective performance characteristics. As shown in Table 2-2, polypropylene, thermoplastic polyester, and nylon account for 80 percent of the 848 million pounds of thermoplastic resins used for reinforced plastics in 1993.

The average annual growth rate for unsaturated polyester, the most commonly used thermoset in reinforced plastics, was 8.5 percent for the period 1991 to 1997. Over the same period, the average annual growth rate for polypropylene, the most commonly used thermoplastic in reinforced plastics as of 1993, was 10 percent.

2.1.1.2 Reinforcements

Most reinforcing materials used in RPC production are fibers, rovings, fabrics, or mats. Fiberglass is the most common material used for mats, but they can also be made from asbestos, paper, metals, sisal, nylon, or cotton. Reinforcements are used in four basic forms: (1) premixed compounds in injection molding and extrusion; (2) woven mats in laminates; (3) preformed woven mats in spray-up or press mold processing; and (4) prepregs, which are semi-cured woven mats impregnated with resins. The amount of fiber reinforcement varies by resin and reinforcing fiber (e.g., fiberglass varies from 5 to 45 percent by weight, cloth from 30 to 70 percent, and carbon and other expensive fibers from 30 to 65 percent) (Rauch, 1991). Using reinforcing fibers provides the following attributes to composites:

- improved tensile and flexural strength, stiffness, modulus, and impact resistance;
- resistance to crazing and cracking; and
- reduced shrinkage (Rauch, 1991).

Table 2-2. Consumption of Reinforced Plastics by Resin Type: 1991-1993^a

| Plastics Resins | Quantity (10 ⁶ lbs) | | |
|----------------------------|--------------------------------|-------|-------|
| | 1991 | 1992 | 1993 |
| Thermosetting resins | 1,641 | 1,792 | 1,878 |
| Unsaturated polyesters | 1,467 | 1,552 | 1,613 |
| Epoxies, other | 174 | 240 | 265 |
| Thermoplastic resins | 719 | 757 | 848 |
| Polypropylene | 205 | 220 | 246 |
| Polyesters | 187 | 195 | 230 |
| Nylon | 173 | 183 | 206 |
| Styrenics ^b | 51 | 51 | 54 |
| Polycarbonate | 65 | 70 | 73 |
| Other ^c | 38 | 38 | 39 |
| Reinforced plastics, total | 2,360 | 2,549 | 2,726 |

^a Reflects weight of resins, fillers, reinforcements, and other additives.

^b Includes SMA, ABS, SAN, etc.

^c Includes modified PPE, PPS, LCP, ketones, etc.

Sources: Society of the Plastics Industry, Inc. *Facts and Figures of the U.S. Plastics Industry*. Washington, DC. September 1994.

Modern Plastics. "Resin Supply: What's in the Pipeline for '93?" January 1993.

Modern Plastics. "Resin Supply: Plotting a Course for Global Supply." January 1994.

The relative improvement in each of these parameters is a function of the type of fiber, amount of fiber, orientation of fiber, fiber surface treatment, and the characteristics of the matrix polymer.

Fiberglass is the most widely used reinforcement for plastics, with carbon the least used, as Table 2-3 shows. Most reinforcement materials were made of inorganic materials, such as fiberglass (roughly 87 percent of all fibrous reinforcements), asbestos (2.9 percent), and carbon and other high performing/high cost fibers (1 percent). Cellulose is the major natural organic used as a reinforcement. It represented about 9 percent of all fibrous reinforcements in 1990. A 1989 EPA ruling that will eventually ban the manufacture,

Table 2-3. Consumption of Fibrous Reinforcements in Plastics: 1990

| Reinforcement | Quantity (10 ⁶ lbs) |
|-----------------------------------|-----------------------------------|
| Fiberglass | 900 |
| Cellulose | 90 |
| Asbestos | 30 |
| Carbon and other high performance | 10 |
| Total | 1,030 |

Source: Rauch Associates, Inc.. *The Rauch Guide to the U.S. Plastics Industry*. Bridgewater, NJ: 1991.
Table 2-12.

processing, and distribution of most products that contain asbestos, has and will continue to reduce the consumption of asbestos as a reinforcement agent and thereby alter the distribution of reinforcement materials used to make composites (Rauch, 1991).

2.1.1.3 Nonreinforcing Fillers

Nonreinforcing fillers not only reduce the cost of composites but frequently impart performance improvements that might not otherwise be achieved by the reinforcement and resin ingredients alone. Performance enhancements offered by some nonreinforcing fillers include easier processing characteristics; improved mechanical, electrical, thermal, and aesthetic properties; and resistance to shrinkage (Rauch, 1991). Fillers that do not offer performance improvements are sometimes referred to as extenders. In comparison to resin and reinforcements, fillers are the least expensive of the major ingredients. In general, fillers are nonmetallic minerals, metallic powders, and organic materials added in fairly high percentages, usually more than 5 percent in terms of volume, and in some cases several times the weight of the polymer.

As Table 2-4 shows, the majority of nonreinforcing fillers used in reinforced plastics are inorganic, particularly calcium carbonate. In 1990, roughly 4.2 billion pounds of fillers were used in plastics products. Nonmetallic minerals account for 90 percent of the total consumption in 1990; calcium carbonate is the dominant mineral filler, with roughly 3.17 billion pounds used, or 75 percent of all fillers consumed that year. Calcium carbonate is by far the most commonly used mineral filler in RPC production. Kaolin clay offers

Table 2-4. Consumption of Nonreinforcing Fillers in Plastics: 1990

| Product | Quantity (10 ⁶ lbs) |
|------------------------|-----------------------------------|
| Inorganics | |
| Minerals | |
| Calcium carbonate | 3,170 |
| Kaolin | 185 |
| Talc | 145 |
| Mica | 34 |
| Other minerals | 450 |
| Other Inorganic | |
| Glass spheres | 23 |
| Natural | 203 |
| Total | 4,210 |

Source: Rauch Associates Inc. *The Rauch Guide to the U.S. Plastics Industry*. Bridgewater, NJ: 1991.
Table 2-7.

several advantages including low water absorption, chemical resistance, and improved electrical properties. Some calcined grades of kaolin even offer additional reinforcement when added to a matrix of nylon or polyolefin resins (Rauch, 1991).

2.1.1.4 Additives

A wide variety of additives are used in composites to modify materials properties and performance. Although these materials are generally used in relatively low quantities as compared to resins, reinforcements, and fillers, they perform critical functions including air release, color, fire resistance, lubricity, speed curing, static reduction, surface smoothness, thermal conductivity, and others (SPI Composites Institute, 1995).

Plasticizers are the most common additive to plastics, as Table 2-5 shows. In 1990, roughly 3.5 billion pounds of fillers, were used in plastics products. Plasticizers accounted for 52 percent of additive consumption in 1990 followed by flame retardants and colorants with 19 and 13 percent, respectively. Plasticizers are essential for producing RPCs in some applications.

Table 2-5. Consumption of Plastics Additives: 1990

| Additive | Quantity (10 ⁶ lbs) |
|---------------------|-----------------------------------|
| Plasticizers | 1,810 |
| Flame Retardants | 661 |
| Colorants | 456 |
| Impact Modifiers | 160 |
| Lubricants | 112 |
| Stabilizers | 99 |
| Organic Peroxides | 47 |
| Blowing Agents | 14 |
| Antistats | 9 |
| Others ^a | 130 |
| Total | 3,498 |

^a Includes viscosity depressants, mold release agents, surfactants, slip agents, biocides, antiblocking agents and catalysts.

Source: Rauch Associates Inc. *The Rauch Guide to the U.S. Plastics Industry*. Bridgewater, NJ: 1991.
Table 2-6.

2.1.2 Production Processes

Application development in the production of composites requires careful selection not only of which materials to use but also of the production process that can combine these inputs into the desired form most efficiently. Table 2-6 provides data on the distribution of the volume of reinforced plastics by process for 1990. In 1990, approximately 2.6 billion pounds of RPCs were shipped from RPC facilities in the United States. Approximately 1.04 billion pounds of RPCs, or 65 percent of the total, were produced using open molding processes. Hand lay-up, spray-up, and continuous lamination processes accounted for about 62 percent of the RPCs produced with open molding processes. Approximately 900 million pounds of RPCs were produced using closed molding processes in 1991. About two-thirds of

Table 2-6. Reinforced Plastics Shipments by Production Process: 1990

| Processing Method | Quantity (10 ⁶ lbs) | Share of Total (%) |
|---|-----------------------------------|-----------------------|
| Open molding | 1,674 | 65 |
| Hand lay-up, spray-up and continuous laminating | 1,038 | 40 |
| Filament winding, pultrusion, and centrifugal casting | 636 | 25 |
| Closed molding | 901 | 35 |
| Compression | 360 | 14 |
| Injection | 523 | 20 |
| Other | 18 | 1 |
| Total | 2,575 | 100 |

Source: Rauch Associates Inc. *The Rauch Guide to the U.S. Plastics Industry*. Bridgewater, NJ: 1991.

this total were produced using injection molding processes, with compression molding processes accounting for most of the remaining RPCs made using closed molding processes. This section provides a more detailed description of these processes with special attention given to the five processes that contribute most to emissions at RPC facilities. As presented below, these processes can be segregated into open and closed molding categories.

2.1.2.1 Open Molding Processes

Open molding processes can be broken down into those that are simple, with minimal capital requirements, and those that are more heavily automated, with higher tooling, start-up, and other capital costs. Hand lay-up and spray-up are two contact molding processes that fit the first category of open molding processes. These two production processes use the simplest materials, technology, and manufacturing methods and are ideally suited for low-to-medium volume production of larger, more complex structural shapes. Other open molding processes, such as centrifugal and rotational casting, lamination, filament winding, and pultrusion processes, have much higher start-up capital costs, often in the millions of dollars.

These processes have relatively low labor costs per unit output. Open molding processes typically only are cost-efficient when used in mass production of uniform RPCs because of high capital costs (SPI Composites Institute, 1995). The following sections provide more detailed descriptions of four open molding processes that contribute to

hazardous air pollutant (HAP) and VOC emissions at the RPC production facilities—hand lay-up, spray-up, filament winding, and pultrusion (LeFlam and Proctor, 1995).

Hand Lay-Up. Hand lay-up is one of the most common low-to-medium volume RPC production processes. It typically involves manual application of general polyester liquid resins to a reinforcement, such as glass fiber mats or woven roving, that are laid against the smooth surface of an open mold. Serrated rollers or squeegees drawn across the preparation help to release any air that may be entrapped in the reinforcement material. Chemical curing, often induced by a catalyst additive, hardens the resin and reinforcement into a structural form that is exceptionally strong for its weight. The resin offers a uniform matrix for the reinforcing material in much the same way that concrete does when used in conjunction with reinforcing bars made of steel (SPI Composites Institute, 1995).

The mold is the primary piece of equipment necessary for the hand lay-up process, as Figure 2-2 illustrates. Prior to hand lay-up production, the mold (which is often itself a composite) is sprayed with a tinted gel-coat and allowed to partially cure. The gel-coat side of the final product takes on the color of the pigment used to tint the gel-coat and has a smooth surface and decorative finish, much like that provided by a high quality paint. The appearance and texture of the other side is rough and abrasive, unless corrective measures, such as applying a tightly woven sail cloth to the back surface prior to curing, or sanding the back-surface after curing are performed. In most applications of hand lay-up, only a single finished side is required (SPI Composites Institute, 1995).

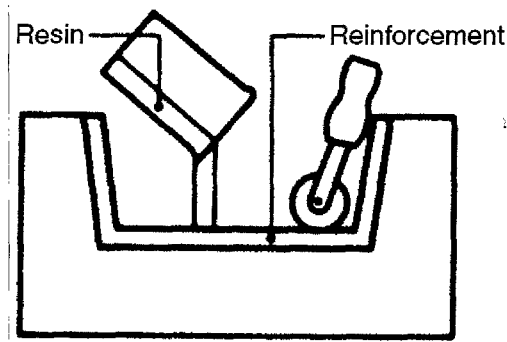


Figure 2-2. Hand Lay-up Processing

Source: SPI Composites Institute. *Introduction to Composites*. Society of the Plastics Industry, Inc. Washington, DC: 1995.

Spray Up. The spray-up process is very similar to hand lay-up processing. It too is best suited to low-to-medium volume production of larger composites with complex shapes. Unsaturated polyesters are also the most commonly used polymer, although isophthaltic polyesters and vinyl esters may also be used. As with hand lay-up, the polymers, reinforcements, fillers, and additives are applied to an open mold that has been sprayed with a pigmented gel-coat and allowed to partially cure.

The primary difference from hand lay-up is that the input materials in the spray-up process are applied to the mold simultaneously, using either an air-atomized or airless spray-up gun. Both types of spray-up guns are designed to automatically chop a continuous feed of glass fiber in lengths ranging from 0.5 to 1.5 inches and then mix both the fiber and a user-determined amount of catalyst into a fan-shaped spray of polymer or polymer/filler mixture (SPI Composites Institute, 1995). This process is illustrated in Figure 2-3.

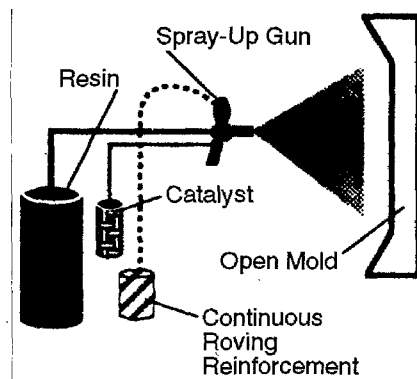


Figure 2-3. Spray-up Processing

Source: SPI Composites Institute. *Introduction to Composites*. Society of the Plastics Industry, Inc. Washington, DC: 1995.

For some applications requiring added structural strength, more fiber reinforcement mats or rovings can be hand laid-up between applications of the sprayed mixture. Rollers or brushes are generally used to remove entrapped air from the mixture after it has been applied to the mold. Twenty-five to 30 pounds of laminate can be applied per minute using some types of spray-up equipment. This speed of application can lessen the labor input requirements relative to hand lay-up but is somewhat offset by the need for a skilled spray-up gun operator to ensure product quality (SPI Composites Institute, 1995).

Filament Winding. Filament winding is a highly automated RPC production process suited to high volume production of strong surface-of-revolution composites, be they open (e.g., springs), cylindrical (e.g., pipes), or closed (e.g., storage tanks and pressure bottles). This process is extremely versatile, offering a wide choice of input materials. Traditional polymer choices have been dominated by thermoset resins (e.g., polyesters, vinyl esters, bisphenol A fumarate resins, furanes, and epoxies), but the use of thermoplastic resins (e.g., nylon, polycarbonates, and acrylic) is under development and gaining popularity. Figure 2-4 offers a simple schematic of a sample filament winding process. The basic steps involve drawing a continuous strand of reinforcing material through a resin bath and then wrapping the impregnated reinforcement around a revolving mold, called a mandrel. Depending on the shape of the intended RPC, the mandrel can advance in one direction as it rotates (for springs and tubular shapes) or can rotate on two axes (for closed cylinders or spheres) (SPI Composites Institute, 1995).

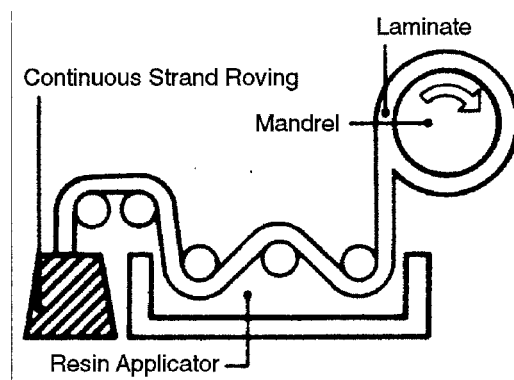


Figure 2-4. Filament Winding

Source: SPI Composites Institute. *Introduction to Composites*. Society of the Plastics Industry, Inc. Washington, DC: 1995.

The most common reinforcement material used is direct processed rovings of glass fiber; however, the choice of reinforcement fibers is virtually unlimited and numerous reinforcement application methods are commonly used. In fact, two or more different reinforcements can be applied in different patterns to a single composite. The ability to vary the type, form, quantity, and orientation of reinforcement materials as filament-wound RPCs are produced allows production designers to optimize the trade-off between input costs and

performance requirements of composites intended for a given application. This is because they can limit the use of more costly, higher performance reinforcements to strategic locations in the composite structure and substitute lower cost fibers elsewhere. The use of hybrid reinforcement methods is increasingly common in filament winding processes. Limitations of filament winding include relatively high VOC emissions and capital investment requirements (SPI Composites Institute, 1995).

Pultrusion. The pultrusion process, shown in Figure 2-5, creates profile shapes like rods, plates, beams, and channels by pulling continuous strands of reinforcements through a resin bath, one or more pre-shaping guides, and ultimately through a heated shaping die where the pultruded RPC is cured into its permanent cross-sectional shape. The last stage in the process is the cutoff where equipment is used to cut the pultruded profile to its intended length. Pulling is achieved using either intermittent or continuous pulling devices. While development is underway to incorporate the use of thermoplastic resins in pultrusion processes, at present most applications are limited to the use of thermoset resins, primarily polyester, but phenolics, epoxies, and esters are also used. Commonly used reinforcement materials include continuous fiber glass rovings, surfacing mats, graphite fibers, chopped and continuous strand mats, and woven tapes (SPI Composites Institute, 1995). Advantages of pultrusion include greater reinforcement orientation, a necessary attribute for some RPC applications, and lower capital equipment costs than most other high-volume RPC production processes. The primary limitations of the process are an inability to vary the cross-sectional characteristics along the length of the pultruded composite and stress resistance that is limited to the direction of the reinforcement material (SPI Composites Institute, 1995).

2.1.2.2 Closed Molding Processes

Closed molding processes, such as the many variants of compression molding, use pre-prepared molding compounds like sheet molding compounds (SMC), bulk molding compounds (BMC), and reinforced thermoplastic sheets as feedstocks to their production processes. These molding compounds are prepared to facilitate mass production of a wide variety of composites, each with its own special physical attributes. These compounds have the advantage of an extended shelf-life. Each compound is produced using fixed proportions of the appropriate polymers, reinforcements, fillers, and other additives needed to impart the specific physical properties and appearance to the composite produced (SPI Composites Institute, 1995). This section provides more detailed descriptions of the most common compression molding processes as well as a closed molding process called injection molding.

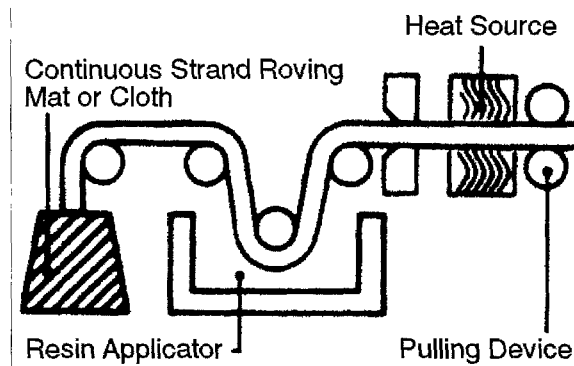


Figure 2-5. Pultrusion

Source: SPI Composites Institute. *Introduction to Composites*. Society of the Plastics Industry, Inc. Washington, DC: 1995.

Compression Molding. There are four primary high-volume RPC production processes commonly called compression molding processes (and many variations of these processes):

- Sheet Molding Compound (SMC),
- Bulk Molding Compound (BMC), including Transfer Molding,
- Wet System Compression Molding, and
- Reinforced Thermoplastic Sheet Compression Molding.

For each of these processes, the chosen composite materials, including all resins, reinforcements, filler, and additives, are compressed into a desired shape in a matched die hydraulic press under pressure ranging from 250 to 3,000 psi (SPI Composites Institute, 1995). The composite feedstock is then held in place while the resin matrix quickly cures into its permanent hardened shape. Significant differences among these processes determine their suitability for a given application. The following sections offer brief descriptions of each of the main high-volume molding processes.

Sheet Molding Compound. SMC is produced by mixing all of the composite materials, except for the reinforcing fibers, into a paste. The paste is then uniformly spread onto two separate “carrier films” that are fed through an SMC machine where the paste is compounded with the reinforcements. The carrier films are held apart, one above the other, while reinforcements, cut from continuous strand rovings, are uniformly distributed on the lower carrier film and then forced together like a fiber reinforcement sandwich as they are fed through a system of rollers that compact and consolidate the SMC. The SMC, with the carrier film still in place, is then rolled up and encased in a nylon sleeve that prevents evaporation of volatiles from the resin matrix that would allow the compound to finish curing. After a period of storage in a climate controlled area, the SMC is thickened to the desired viscosity for its intended application and then taken to a molding press where it is cut to its desired shape. The carrier films are then removed and the SMC permanently compressed into its ultimate shape in a heated matched die mold (SPI Composites Institute, 1995).

SMC molding has high start-up capital costs associated with it. However, while the tooling costs of SMC compression molding are much higher than for most other RPC production processes, they are still generally lower than would be required to produce equally strong shapes from metal inputs. Retooling an SMC process to modify the design of a composite is much quicker than in metal stamp molding operation. Other advantages include the ability to consolidate many parts into a single RPC. These attributes make SMC molding very attractive to such high-volume end users as producers of automobiles, appliances, construction, and electrical product industries. SMC compression molding is used to produce more composites of greater value than any other RPC production process (SPI Composites Institute, 1995).

Bulk Molding Compound. Bulk molding compound, like SMC, is more a material than a process. BMC generally consists of approximately 20 percent reinforcement, 50 percent fillers and additives, and 30 percent resin matrix. The compound can be tinted to a desired color and, through strategic selection of input materials, can be prepared to afford exceptional mechanical and fire retardant properties. The basic process entails combining the desired composite materials into a molding compound that resembles putty and then placing the compound into a compression mold. Molding typically takes place at temperatures between 250 and 350 °F and at pressures ranging from 350 to 2,000 psi (SPI Composites Institute, 1995). BMC is also used in transfer molding and injection molding processes to

produce more complex shapes with closer mold tolerances than can be achieved using matched die compression molds.

The advantages of BMC include reduced costs and improved stiffness and fire retardance due to lower reinforcement loadings and increased filler loadings. BMC can also be molded into intricately detailed, precise shapes with inserts affixed during the molding process.

Wet System Compression Molding. Wet system compression molding differs from SMC and BMC compression molding in that a matrix of liquid resin mixed with fillers and additives is pumped or poured onto dry reinforcement mats that have been placed inside of the matched die mold. Thus, unlike SMC and BMC processing, the resin is not introduced to the reinforcements prior to molding. Hydraulic pressure is exerted on the mold, forcing the resin to permeate the reinforcement materials and fixing, and the composite remains under pressure until it has fully cured. Typical curing temperatures are 250 to 350 °F, much like SMC and BMC molding, but the pressure requirements are much lower, in the range of 250 to 1,000 psi (SPI Composites Institute, 1995).

Like SMC and BMC, wet system molding can produce RPCs with two finished surfaces. Other advantages of this process include equipment and tooling savings, due to the reduced pressure requirements, and higher reinforcement loading, which affords superior mechanical properties. The disadvantages of wet system molding include an inability to provide undercuts or reinforcing ribs to add strength to the composite, higher labor costs, and more process waste than is typical with BMC and SMC molding processes.

Reinforced Thermoplastic Sheet Molding. Reinforced thermoplastic sheet molding is quite similar to SMC, in that the composite materials are all combined and shaped into sheets prior to molding, but as the name implies, this process is designed for use with thermoplastic resins. Another difference is that the sheet is cut to fit entirely within the mold and is preheated prior to placement in the mold. When the mold is closed and pressure is applied, the thermoplastic resins start to flow and conform to the shape of the mold. The temperature of the mold is then controlled for 30 to 90 seconds to permit the molded sheet to solidify and permit removal of the RPC from the mold (SPI Composites Institute, 1995). This process is sometimes called stamping, because the mold used is similar to a steel stamping press.

Advantages of this process include unlimited shelf life for the input sheets, fast molding cycles, recyclable scrap, and potential for parts consolidation relative to metals.

Capital costs are comparable to SMC molding. There are, as yet, few suppliers of the input sheets because this process is new.

Injection Molding. Injection molding is perhaps the most versatile and widely applied process for mass producing fairly complex composites of absolute dimensional accuracy. It can be used for parts of any size for which a mold can be built and is ideally suited to high-volume applications. Each compression molding machine is capable of producing thousands of detailed RPCs per hour. As illustrated in Figure 2-6, the same equipment can be used to mold both thermoplastic resins and thermoset resins into RPCs. The only difference is the temperature at which the resin is kept during the curing stage of the process within the mold. This process is most commonly used to shape RPCs from thermoplastic resins (e.g., nylon, acetal, PVC, polyethylene, SAN, polycarbonate, and ABS), which require cooler curing temperatures, but compression molding of thermoset resins (e.g., polyester, phenolic, epoxy and urethane) is gaining popularity (SPI Composites Institute, 1995).

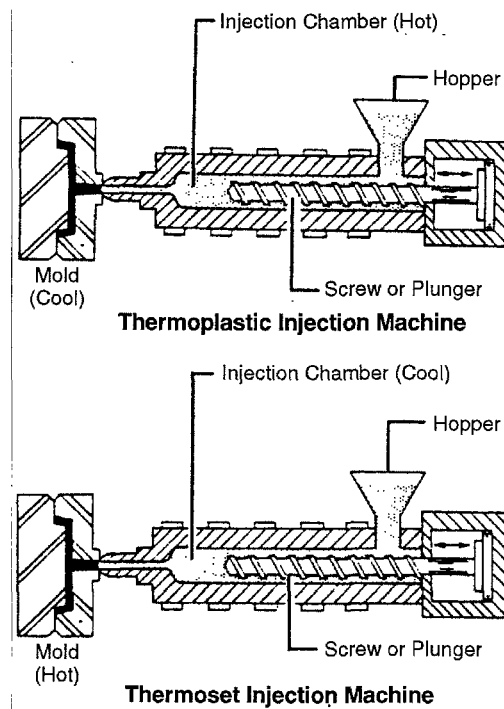


Figure 2-6. Injection Molding

Source: SPI Composites Institute. *Introduction to Composites*. Society of the Plastics Industry, Inc. Washington, DC: 1995.

The basic steps in the standard injection molding process consist of conveying granular or pelletized thermoplastic resin from a supply hopper to an opening at the opposite end of a heated metal chamber, using an auger to control the rate that the resin advances to the tip. The resin is thus heated to a semi-fluid state melting or plasticizing the resin and can be injected into the mold at the tip of the chamber with a twist of the auger. The mold is kept at a cool temperature and held closed while the resin cools down and solidifies. Once the resin has solidified, the mold is opened to eject the composite from the mold and the whole process can be restarted.

2.2 Products

There is great diversity in the types of products made using most of these processes. Among the open molding processes, product diversity is especially extensive in the hand lay-up, spray-up, and filament winding processes. Among closed molding processes, product diversity is greatest for the compression and injection molding processes. Table 2-7 describes the basic shape characteristics that are best produced by each RPC production process and lists examples of composite products that result from each process.

2.3 Costs of Production

There are three variable inputs in reinforced plastic production: raw materials, labor, and energy. Raw materials include plastic resins, reinforcing materials, and fillers. Labor and energy are used throughout production as well as for final product transport.

Prices for thermoset resins have increased since 1996, while most thermoplastic prices have fallen over the same period, as Table 2-8 shows. Among thermoset resins, unsaturated polyester and phenolics are close in price, while epoxy has a higher price than both. PVC and polypropylene are the least expensive thermoplastics, while the price of nylon is more than four times greater than these two. Table 2-9 provides prices for fibrous reinforcing materials. For 1997, the price of fiberglass, the most common reinforcement, is approximately \$1.11 per pound. The price of carbon is the most expensive and is primarily used in high performance applications (\$10 to \$30 per pound).

Many producers use fillers in order to minimize the amount of higher-cost resins needed per unit output (see Table 2-9). RPC manufacturers frequently select calcium carbonate because of its relative low cost (\$0.08 per pound). Other popular low cost fillers include kaoline and alumina trihydrate (\$0.05 and \$0.13 per pound respectively). As noted in

Table 2-7. Compatibility of RPC Production Processes with Shape Characteristics and Specific Products

| Process | Shape Characteristic | Product Examples |
|--|---|---|
| Open molding processes | | |
| Hand lay-up and spray-up | Large, complex | Boat hulls, auto and truck body parts, swimming pools, tanks, corrosion resistant equipment, furniture, duct work, and equipment housings |
| Filament winding | Round, rigid | Pressure bottles, airplane bodies, underground storage tanks, drive shafts for cars and trucks, sailboat masts, and gun barrels |
| Pultrusion | Uniform cross-section | Corrosion resistant rods, beams, channels, and plates |
| Continuous laminating | Thin, flat, or curved profiles | Flat and corrugated paneling, panels for truck trailers, road signs, and refrigerator liners |
| Centrifugal casting | Uniform wall thickness | Larger pipes, tanks |
| Closed molding processes | | |
| Compression molding | | |
| SMC compression molding | Large or small shapes can be smoothly ribbed, embossed, or high complex | Automotive body panels and front end assemblies, appliances, air conditioner base, office equipment housing |
| BMC compression molding | Smaller complex | Air conditioner components, pump housings, computer components, power tools, motor parts, gear cases, circuit board covers, garbage disposal housings |
| Reinforced thermoplastic sheet molding | Simple, thinwall | Material handling pellets, tray, and shelving; automotive bumper beams, floor pans, battery trays, radiator supports; helmets; flooring; concrete pouring forms; and chair shells |

(continued)

Table 2-7. Compatibility of RPC Production Processes with Shape Characteristics and Specific Products (Continued)

| Process | Shape Characteristic | Product Examples |
|--------------------------------------|---|--|
| Closed molding processes (continued) | | |
| Wet system compression molding | Contoured, medium-wall thickness | Trays, outboard motor shrouds, appliances, automotive applications, and sinks |
| Transfer molding | Simple configurations | Body components for trucks, sports car bodies, automotive body panels, marine parts, small boats, plumbing components, equipment housings, and electrical components |
| Bag molding | Simple, large, contoured | High performance aircraft parts, and aerospace components |
| Reaction injection molding (RIM) | Large, intricate, high performance, solid or cellular | Automobile and truck body panels, bumper beams for cars and trucks, floor pans for cars and trucks, and pick-up truck beds |
| Rotational molding | Hollow bodies, complex | Water pressure tanks, water softener tanks, and filters |

Sources: Rauch Associates Inc. *The Rauch Guide to the U.S. Plastics Industry*. Bridgewater, NJ: 1991.

SPI Composites Institute. *Introduction to Composites*. Society of the Plastics Industry, Inc. Washington, DC: 1995.

Section 2.1.1.4, additives are also used in relatively low quantities to enhance particular properties of RPCs . The Agency computed a weighted average price for additives in 1997 of \$0.88 per pound.

2.4 Uses and Consumers of Reinforced Plastics

RPCs are an input into the production of a variety of products ranging from children's toys to aerospace components and bathtubs to boat hulls. Therefore, the demand for RPCs is derived from the demand for these products, which can be found within one of the following major segments of the market for RPCs:

Table 2-8. Plastic Resin Prices: 1996-1999

| Resin | Price (\$/lb) | | | |
|------------------------------------|---------------|-----------|-----------|-----------|
| | 1996 | 1997 | 1998 | 1999 |
| Thermosets | | | | |
| Epoxy ^a | 1.25-1.37 | 1.30-1.42 | 1.30-1.42 | 1.30-1.42 |
| Unsaturated Polyester ^a | .73-.84 | .75-.86 | .75-.86 | .75-.86 |
| Phenolic ^a | .72-.82 | .74-.84 | .74-.84 | .74-.84 |
| Thermoplastics | | | | |
| ABS ^b | .96-1.01 | .88-.91 | .68-.71 | .64-.67 |
| Polypropylene ^a | .42-.44 | .39-.41 | .29-.31 | .28-30 |
| Polystyrene ^a | .48-.50 | .38-.40 | .38-.40 | .41-.43 |
| PVC ^a | .39-.40 | .38-.41 | .27-.30 | .29-.32 |
| Nylon ^c | 1.28-1.38 | 1.28-1.38 | 1.39-1.49 | 1.29-1.39 |

^a General purpose.

^b Medium-impact.

^c Type 6.

Source: *Plastics News*. "Resin Pricing." Updated May 13, 1999. As obtained on May 17, 1999.
<<http://www.plasticsnews.com>>.

- Aircraft/Military: flight surfaces, cabin interiors, aerospace components, military helmets, armament, rocket launchers.
- Appliances/Business Machines: refrigerators, freezers, ranges, microwave ovens, power tools, small appliances, computer housings, calculators.
- Construction: swimming pools, rain gutters, molds for concrete, bathtubs, shower stalls, whirlpools, spas, highway signs, cooling tower components, paneling for greenhouses, patios, railings and other architectural components.
- Consumer Products: fishing rods, golf clubs, skis, tennis rackets, furniture, campers, snowmobiles, exercise equipment, seating, counter tops, serving trays, boxes and containers, microwave cookware.
- Corrosion Resistant Products: pipe fittings, ducts, hoods, tanks, pumps, filtration equipment, and a wide variety of other chemical resistant products for use in the waste/wastewater treatment, chemical processing, semiconductor, and petrochemical industries.

Table 2-9. Selected Plastic Reinforcement and Filler Prices: 1997

| Input | Price (\$/lb) |
|-----------------------|----------------------|
| Reinforcements | |
| Fiberglass | \$1.11 |
| Cellulose | \$0.52 ^a |
| Carbon | \$10–30 |
| Average | \$1.25 |
| Fillers | |
| Calcium carbonate | \$0.08 ^a |
| Kaolin | \$0.05 ^a |
| Alumina trihydrate | \$0.13 |
| Talc | \$0.30 |
| Mica | \$0.21 ^a |
| Other minerals | \$0.08 ^a |
| Glass spheres | \$0.78 ^a |
| Natural | \$0.05 ^a |
| Average | \$0.09 |
| Additives | |
| Average | \$0.88 |

^a Price computed by dividing value by quantity and adjusting by a producer price index (PPI) where appropriate.

Sources: U.S. Geological Survey. 1997. Minerals Yearbook: Clays. [online] <<http://minerals.usgs.gov/minerals/pubs/commodity/myb>>. Obtained January 21, 2000.
U.S. Geological Survey. 1997. Minerals Yearbook: Mica. [online] <<http://minerals.usgs.gov/minerals/pubs/commodity/myb>>. Obtained January 21, 2000.
Rauch Associates. 1991. *The Rauch Guide to the U.S. Plastics Industry*. Bridgewater, NJ: Rauch Associates, Inc.
Murphy, John. 1994. *The Reinforced Plastics Handbook*. Oxford, UK: Elsevier Advanced Technology.
U.S. Bureau of Labor Statistics. 2000. Producer Price Index—Commodities: WPUSOP9200, Intermediate Materials Less Food and Energy, 1990–2000. [online] <<http://www.bls.gov>>. Obtained January 20, 2000.
Shearer, Brent. April 15, 1996. “Carbon Fibers Adjusting to Changes.” *Chemical Marketing Reporter*.

- Electronic/Electrical: rods, tubes, circuit breaker boxes, molded parts, housings, substation equipment, electronic connections, pole line hardware, microwave antennas, and many other electrical and electronic applications.
- Marine: boat hulls, motor covers, marine docks, moorings, floats, buoys, canoes, kayaks, and other components and hardware for naval, pleasure, and commercial water craft.
- Transportation: body panels for cars, buses, and tractor trailers, truck cabs, boxcar doors, subway seating, heater housings, front end assemblies, drive shafts, wind deflectors, grill opening panels, tail light housings, fender liners, instrument panels, and other diverse parts and accessories for land transportation and utility vehicles.
- Other: all other composites applications. One significant new category of applications the repair/replacement of components of the civil infrastructure. Product examples include: guardrails, sign posts, and structural supports for highways and bridges.

Over time, the need for lightweight structural materials that meet strength, stiffness, and other mechanical property requirements for high performance applications has prompted major developments in production practices in the end-use markets. The characteristics demanded vary by the market (e.g., construction, transportation, consumer goods, or other product manufacturer). For example, the ability to replace an assembly of several metal parts with a single molded composite is very appealing to manufacturers of appliances and transportation equipment. The chemical resistance properties of RPCs allow users in the construction and marine market segments to avoid the higher maintenance costs associated with the metal and wood materials that they traditionally used.

The strength-to-weight ratios for composites are typically greater than those of metals. As an example, phenolic composites have greater yield strengths than steel or aluminum, although resistance to bending and the resistance to elongation may be superior in metals depending on the type of reinforcement in the plastic (Murphy, 1994). Composites have low flammability properties, which make composites superior to wood for applications susceptible to fire. Table 2-10 provides some examples of these desired demand characteristics for selected end uses and associated products.

Table 2-10. Demand for Reinforced Plastic Composites: Some Examples

| End-User Industries and Product Markets | Demand Characteristics | Product Examples |
|---|--|---|
| Aircraft/aerospace/military | Lightweight, moldability, and versatile nature | Structures and interiors of both military and commercial planes |
| Appliances/business equipment | Parts consolidation, design flexibility, and high strength to weight ratios | Dishwasher panels, freezers, small appliances, computer housings, and radios |
| Construction | Corrosion resistance, high strength to weight ratio, custom finishing, longer life-cycle and/or fewer maintenance requirements | Beams, columns, roof trusses, soffit, siding, flooring, bathtubs, sinks, shower stalls, whirlpools and spas |
| Marine | Large, rigid, continuous shapes with smooth, corrosion-resistant finishes and high strength to weight ratios | Boat hulls, jet skis, and other marine craft |
| Transportation | Parts consolidation, light weight, continuous shapes with smooth corrosion-resistant finishes | Body panels, front ends, bumpers, and interior dashboards for automobiles, mobile homes, buses, and trucks. |

Source: Society of the Plastics Industry, Inc. *Introduction to Composites*. 2nd ed. Washington, DC. The Composites Institute. 1992.

Land transportation products consumed the most reinforced plastics in 1997, followed by construction, as Figure 2-7 illustrates. The land transportation segment alone used 1,095 million pounds, which accounts for 32 percent of the 3.4 billion pounds of RPCs consumed in 1997. Construction applications, the second largest end-use category, consumed 700 million pounds of composites during 1997. Other significant market segments are marine and electrical products. Producers serving the marine segment will not be subject to the proposed controls; they will be separately addressed by the Agency.

Reinforced Plastics Shipments = 3,422 million lbs.

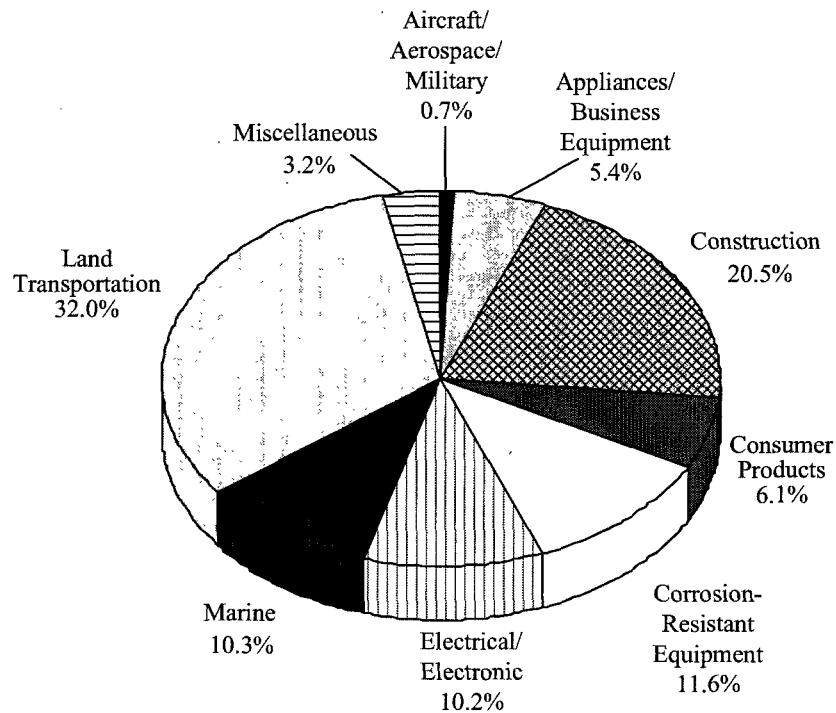


Figure 2-7. Consumption of Reinforced Plastic Composites by Market Segment: 1997

^aIncludes reinforced thermoset and thermoplastic resins, reinforcements, and fillers.

Source: Society of the Plastics Industry, Inc. 1998. *Facts and Figures of the U.S. Plastics Industry*. Washington, DC: SPI.

Table 2-11 indicates that consumption has risen from 1989 levels in all end-use categories except for aviation/aerospace/military, which has declined because of the recent reductions in U.S. government spending on defense. Total shipments have increased every year since 1991. The growth rate for consumption by land transportation was highest for the period 1984-1997, followed by electrical applications. Causes for aggregate growth vary.

Table 2-11. Consumption of Reinforced Plastic Composites by End Use: 1984-1997 (10⁶ lbs)^a

| End Use | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | Average Annual Growth Rate (1984-1997) |
|--------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--|
| Aircraft/ aerospace/ military | 29 | 32 | 37 | 36 | 39 | 41 | 39 | 39 | 32 | 25 | 24 | 24 | 24 | 24 | -3.4% |
| Appliances/ business equipment | 123 | 133 | 137 | 141 | 150 | 151 | 153 | 135 | 143 | 148 | 161 | 167 | 170 | 185 | 2.3% |
| Construction | 430 | 445 | 456 | 506 | 495 | 470 | 468 | 420 | 483 | 530 | 597 | 627 | 643 | 700 | 3.2% |
| Consumer products | 143 | 142 | 149 | 167 | 169 | 158 | 165 | 149 | 162 | 166 | 175 | 184 | 192 | 210 | 2.3% |
| Corrosion-resistant equipment | 310 | 295 | 291 | 329 | 349 | 335 | 350 | 355 | 332 | 352 | 376 | 395 | 405 | 396 | 2.3% |
| Electrical/ electronic | 189 | 191 | 201 | 214 | 230 | 229 | 241 | 231 | 260 | 275 | 299 | 315 | 328 | 348 | 4.7% |
| Marine | 309 | 335 | 340 | 413 | 452 | 405 | 375 | 275 | 304 | 319 | 364 | 375 | 383 | 353 | 0.1% |
| Land transportation | 540 | 563 | 585 | 656 | 695 | 677 | 705 | 682 | 750 | 822 | 946 | 984 | 1,009 | 1,095 | 5.3% |
| Miscellaneous | 80 | 82 | 83 | 75 | 80 | 76 | 79 | 74 | 83 | 89 | 102 | 107 | 111 | 111 | 2.8% |
| Total ^b | 2,153 | 2,218 | 2,279 | 2,536 | 2,658 | 2,542 | 2,575 | 2,360 | 2,549 | 2,726 | 3,043 | 3,176 | 3,263 | 3,422 | 3.2% |

^a Includes thermosetting and thermoplastic resins, reinforcements, and fillers.

^b Parts may not sum to totals due to independent rounding.

Sources: Lindsay, Karen F. 1996. "State of the Industry: 1995-96." *Composites Design and Application*. February. Rauch Associates. 1991. *The Rauch Guide to the U.S. Plastics Industry*. Bridgewater, NJ: Rauch Associates, Inc.

Society of the Plastics Industry, Inc. 1994. *Facts and Figures of the U.S. Plastics Industry*. Washington, DC: SPI.

Society of the Plastics Industry, Inc. (SPI). 1998. *Facts and Figures of the U.S. Plastics Industry*. Washington, DC: SPI.

across individual market segments. Growth may be driven by advances in RPC production processes or increased demand for specific final products. Demand in some end-use categories is strongly influenced by fluctuations in consumer confidence or by changes in government spending priorities.

The growth for particular RPC processes and resins may differ from the observed aggregate rates of growth for the markets they serve, which is significant because the RPC source category to be regulated includes only thermosetting resins—mainly unsaturated polyesters. Table 2-12 presents information on consumption of reinforced unsaturated polyesters based on consumption data by end use for 1984 through 1993 from *Predicasts Basebook* and *Modern Plastics*. In contrast to the aggregate growth rates across end-use markets, Table 2-12 shows that growth for reinforced unsaturated polyesters was positive in electrical/electronic (0.7 percent), aircraft/aerospace/military (0.6 percent), appliances/business equipment (0.4 percent annually), and corrosion resistant equipment (0.2 percent). It appears that reinforced unsaturated polyesters are losing market share in many end uses as technological advances allow thermoplastic resins to be used in a wider range of processes and applications.

Some RPC processes may serve multiple end-use markets and, thus, have a different growth rate than those listed in Tables 2-11 and 2-12. In particular, industry sources cited in *Modern Plastics* state that pultruded parts using reinforced polyesters are replacing aluminum, wood, and polyvinyl chloride in various markets and are expected to have a 15 to 25 percent growth rate over the next 5 years (*Modern Plastics*, 1993). Pultrusion is a fully automated fabrication process with low tooling and labor costs that produces continuous, cross-sectional composite profiles, all of which are expected to allow it to continue its strong growth and penetration of traditional material profile markets in the 1990s. Growth is expected to be particularly significant in the electrical and corrosion-resistant markets, with opportunities increasing in the construction and aerospace markets (*Modern Plastics*, 1994).

2.5 Manufacturing Facilities

The information provided in this section is based on EPA's 1993 survey of the reinforced plastics industry (EPA, 1993). Although roughly 700 facilities participated in the survey, only 433 facilities were determined to be potential major sources of HAP emissions from the production of reinforced plastics. Thus, this section focuses on those 433 facilities likely to be subject to the proposed air regulations.

Table 2-12. Consumption of Reinforced Unsaturated Polyester by End Use: 1984-1993 (10⁶ lbs)^a

| End Use | Predicast Code | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | Average Annual Growth Rate ('84-'93) ^b |
|-------------------------------|----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---|
| Aircraft/aerospace/military | 30752-20 | 26 | 28 | 32 | 33 | 34 | 35 | 34 | 36 | 31 | 25 | 0.6% |
| Appliances/business equipment | 30754-00 | 86 | 85 | 87 | 90 | 93 | 93 | 93 | 84 | 88 | 91 | 0.4% |
| Construction | 30760-00 | 420 | 400 | 402 | 393 | 414 | 426 | 384 | 337 | 387 | 418 | -0.7% |
| Plumbing fixtures | 30765-00 | 109 | 101 | 102 | 100 | 112 | 115 | 106 | 88 | 94 | 96 | -1.3% |
| Panels and siding | 30761-00 | 125 | 122 | 123 | 115 | 117 | 125 | 109 | 99 | 108 | 116 | -1.6% |
| Glazing and skylights | 30761-40 | 45 | 41 | 40 | 39 | 42 | 50 | 36 | 24 | 27 | 29 | -5.8% |
| Pipe, fittings, conduit | 30766-00 | 141 | 136 | 137 | 139 | 143 | 158 | 139 | 126 | 122 | 122 | -1.4% |
| Consumer products | 30770-00 | 130 | 132 | 130 | 130 | 135 | 138 | 127 | 120 | 122 | 124 | -0.9% |
| Corrosion-resistant equipment | NA | 310 | 320 | 322 | 326 | 338 | 350 | 336 | 329 | 299 | NA | 0.2% |
| Electrical/electronic | 30755-00 | NA | 48 | 52 | 55 | 53 | 53 | 53 | 50 | 53 | 55 | 0.7% |
| Marine | 30752-40 | 308 | 320 | 324 | 350 | 375 | 353 | 300 | 221 | 243 | 255 | -3.7% |
| Land transportation | 30752-00 | 200 | 220 | 200 | 195 | 207 | 221 | 215 | 185 | 190 | 207 | -0.5% |
| Miscellaneous | NA | NA | 52 | 50 | 50 | 51 | 52 | 48 | 45 | 52 | NA | -0.7% |
| Total ^c | | 1,592 | 1,605 | 1,599 | 1,622 | 1,700 | 1,721 | 1,590 | 1,407 | 1,552 | 1,613 | -0.5% |

^a Includes weight of resin, reinforcements, and fillers.

^b Or widest range of available years.

^c Parts may not sum to totals due to independent rounding.

Sources: *Modern Plastics*. "Resin Supply: Plotting a Course for Global Supply." January 1994.

Predicasts Basebook. November 1992. Foster City, CA: Information Access Corporation.

2.5.1 Location

Based on the 1993 updated industry screening survey, Figure 2-8 identifies the location of the 433 major source facilities producing reinforced plastics in 1993. Ohio, Indiana, California, Texas, and Pennsylvania are the top five states in order of number of major source facilities.

2.5.2 Employment

The 1993 survey data indicate that employment at these major source facilities ranged from 2 to 1,250 per facility in 1997 with an average of 84 employees for those facilities reporting their employment level. Table 2-13 provides the distribution of major source facilities reporting employment data. Over 80 percent of the 389 facilities reporting employment data had 100 employees or fewer. The vast majority of the remaining facilities reported employment levels between 101 and 500. Less than 3 percent of facilities reporting employment reported have more than 500 employees.

2.6 Facility Ownership

Facilities comprise a site of land with plant and equipment that combine inputs (raw materials, fuel, energy, and labor) to produce outputs (reinforced plastics). Companies that own these facilities are legal business entities that have the capacity to conduct business transactions and make business decisions that affect the facility. The terms facility, establishment, plant, and mill are used synonymously in this analysis and refer to the physical location where products are manufactured. Likewise, the terms company and firm are used synonymously and refer to the legal business entities that own the facilities. As seen in Figure 2-9, the chain of ownership may be as simple as one facility owned by one company or as complex as multiple facilities owned by subsidiary companies.

Potentially affected firms include entities that own facilities manufacturing reinforced plastics. In 1993, 356 companies owned the 433 major source facilities, according to the EPA industry survey (EPA, 1993). Annual sales data were available for 314 of these companies (88 percent). Based on the available small company sales and employment observations, the Agency also estimated sales for 39 of the 42 remaining companies by calculating the ratio of sales to employment for each SIC code and applying the appropriate ratio to the number of employees for each company without sales data. Appendix A lists these companies and their sales and employment figures where available.

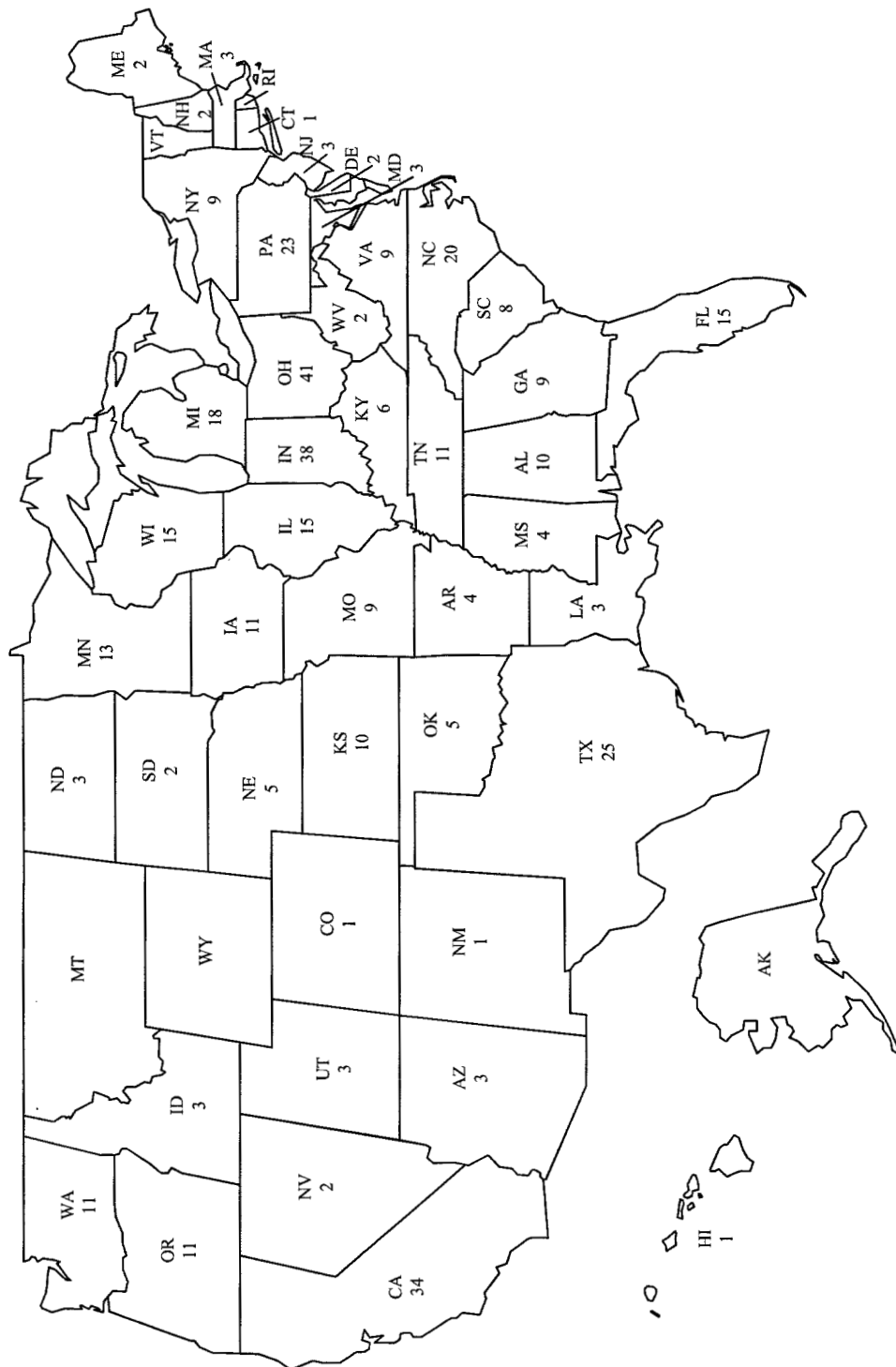


Figure 2-8. Geographic Distribution of Major Source Facilities

Table 2-13. Distribution of Major Source Facilities by Employment

| Employment Range | Number of Facilities | Share of Reporting Facilities (%) |
|-------------------------|-----------------------------|--|
| 0–100 | 313 | 80.5 |
| 101–250 | 46 | 11.8 |
| 251–500 | 20 | 5.1 |
| 501–750 | 4 | 1.0 |
| 751–1,000 | 5 | 1.3 |
| > 1,000 | 1 | 0.3 |
| Total reporting | 389 | 100.0 |
| Not Available | 44 | |

2.6.1 Size Distribution

Firm size is likely to be a factor in the distribution of the regulatory action's financial impacts. The 356 firms owning the 433 manufacturing facilities range in size from 3 to 647,000 employees. Table 2-14 shows the size distribution of potentially affected firms by total employment. The majority of firms (78 percent of those with employment data) have 500 employees or fewer. Only 5 percent report employment between 500 and 1,000, while 18 percent report employment over 1,000. Thus, it appears that this industry is composed of a large number of very small and very large firms, which likely results from a large number of smaller specialty product manufacturers and larger integrated manufacturers of durable products.

The majority of firms (82 percent of those with sales data) generated less than \$100 million in annual sales, as Table 2-15 shows. Nine percent report annual sales between \$100 million and \$1 billion, and 9 percent report sales over \$1 billion annually. The distribution of sales appears to be less skewed than the distribution of employment across firms.

2.6.2 Issues of Vertical and Horizontal Integration

Vertical integration is a potentially important dimension in analyzing firm-level impacts because the regulation could affect a vertically integrated firm on more than one

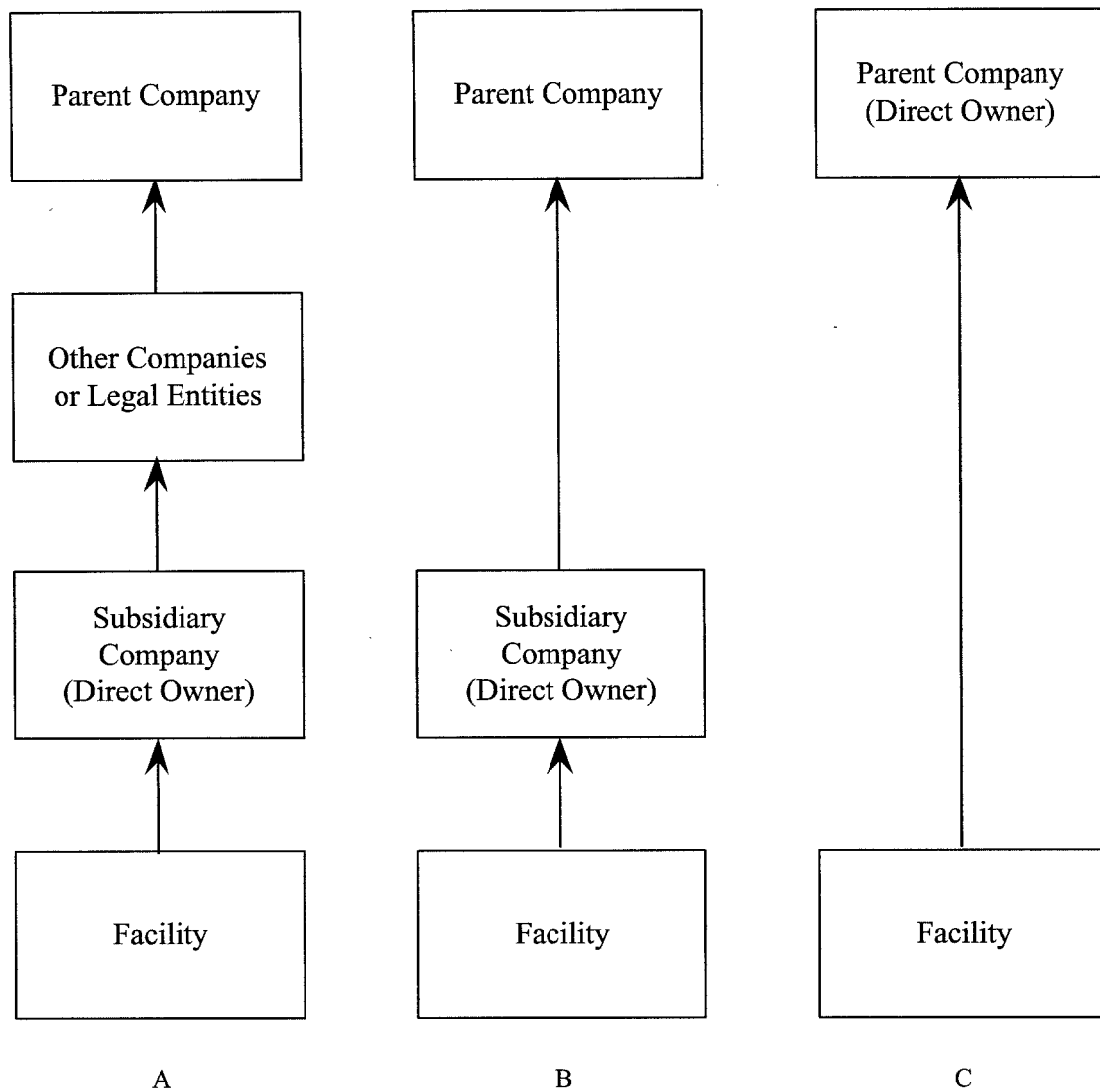


Figure 2-9. Alternative Chains of Ownership

level. For example, the regulation may affect companies for whom reinforced plastic production is only one of several processes in which the firm is involved. A company that produces reinforced plastics for example may also be involved in manufacturing automobiles, aircraft, sporting goods, and appliances. This firm would be considered vertically integrated because it is involved in more than one level of production including reinforced plastics. A regulation that increases the cost of manufacturing reinforced plastics

Table 2-14. Distribution of Potentially Affected Firms by Employment

| Employment Range | Number of Firms | Share of Total (%) |
|-------------------------|------------------------|---------------------------|
| 0–100 | 194 | 55.6 |
| 101–250 | 55 | 15.8 |
| 251–500 | 22 | 6.3 |
| 501–750 | 10 | 2.9 |
| 751–1,000 | 7 | 2.0 |
| >1,000 | 61 | 17.5 |
| Total | 349 | 100.0 |
| Not Available | 7 | |

Table 2-15. Distribution of Potentially Affected Firms By Sales

| Company Sales | Number of Firms | Share of Total (%) |
|----------------------|------------------------|---------------------------|
| Less than \$5M | 127 | 36.0 |
| \$5M to \$10M | 65 | 18.4 |
| \$10M to \$25M | 52 | 14.7 |
| \$25M to \$50M | 27 | 7.6 |
| \$50M to \$100M | 20 | 5.7 |
| \$100M to \$250M | 12 | 3.4 |
| \$250M to \$500M | 13 | 3.7 |
| \$500M to \$1B | 6 | 1.7 |
| \$1B or greater | 31 | 8.8 |
| Total | 353 | 100.0 |
| Not Available | 3 | |

will also affect the cost of producing the final products that use reinforced plastics in the production process.

Horizontal integration is also a potentially important dimension in firm-level impact analysis. This is because a diversified firm may own facilities in unaffected industries, giving them resources to spend on complying with this regulation—if they so choose. The potentially affected firms in Appendix A demonstrate some diversification as evidenced by the number of subsidiaries and divisions listed. Most are part of larger firms or holding companies that are involved in several different industries.

2.7 Small Businesses

The Regulatory Flexibility Act (RFA) of 1980 as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996 requires that the Agency give special consideration to small entities affected by Federal regulation. This section focuses on identifying the small businesses affected by the proposed NESHAP.

2.7.1 Identifying Small Businesses

The following secondary sources were used to obtain data for the 433 affected manufacturers identified in the industry screening survey (EPA, 1993):

- Business and Company ProFile (Information Access Corporation, 1998)
- Dun and Bradstreet Market Identifiers (Dun & Bradstreet, 1998)
- Ward's Business Directory of U.S. and Private and Public Companies (Gale Research, 1998)
- Worldscope (Disclosure Inc., 1998)
- Standard & Poor's Corporations (Dialog Information Service, 1997)
- Manufacturing USA (Gale Research, 1996)
- Company 10-K Reports

We identified the ultimate parent company and obtained sales and employment data for companies for which data are available. Based on available secondary data, the Agency has determined that 356 parent companies are affected by the regulation. Employment data could be obtained from the above sources for 349 of these parent companies (98 percent).

The Small Business Administration (SBA) defines small businesses based on industry size standards (SBA, 1996). Table 2-16 presents the size standards for the SIC codes covered by the industry survey. As shown, the small business definition for the RPC industry ranges from 500 to 1,000 employees. We developed a company's size standard based on the reported SIC code for its facilities. In determining the companies' SIC, we made the following assumptions:

- In cases where companies own facilities with multiple SICs, the most conservative SBA definition was used. For example, if a company owned facilities within SICs 3714 (size standard = 750 employees) and 3089 (size standard = 500 employees), we assumed the size standard to be 750 employees.
- Thirty-eight facilities report an SIC code of 3079. To our knowledge, this SIC code is not currently used. Therefore, we assigned SIC 3089 to these facilities.
- Twenty-four facilities report no SIC code. We assigned these facilities the most conservative size standard of 1,000 employees.

Based on the SBA's definitions, 278 companies out of 356 (78 percent) were identified as small, as Figure 2-10 shows. These companies own 302 facilities (70 percent of all RPC facilities). Appendix A lists the companies identified as small for this analysis.

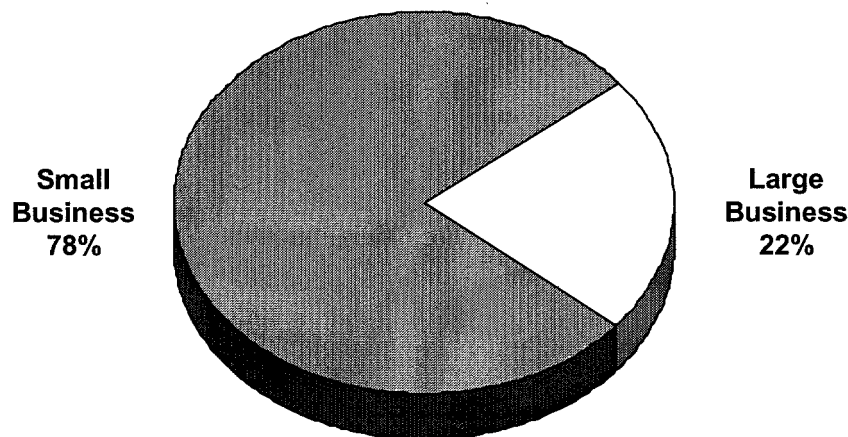


Figure 2-10. RPC Firms by Size

Table 2-16. Small Business Administration Size Standards for RPC—Companies by SIC

| SIC | Small Business Standard | SIC | Small Business Standard |
|------|-------------------------|------|-------------------------|
| 2434 | 500 | 3564 | 500 |
| 2519 | 500 | 3589 | 500 |
| 2522 | 500 | 3612 | 750 |
| 2541 | 500 | 3613 | 750 |
| 2599 | 500 | 3621 | 1,000 |
| 2821 | 750 | 3647 | 500 |
| 3082 | 500 | 3663 | 750 |
| 3083 | 500 | 3679 | 500 |
| 3084 | 500 | 3711 | 1,000 |
| 3087 | 500 | 3713 | 500 |
| 3088 | 500 | 3714 | 750 |
| 3089 | 500 | 3715 | 500 |
| 3281 | 500 | 3716 | 1,000 |
| 3296 | 750 | 3728 | 1,000 |
| 3299 | 500 | 3743 | 1,000 |
| 3431 | 750 | 3792 | 500 |
| 3499 | 500 | 3799 | 500 |
| 3531 | 750 | 3821 | 500 |
| 3533 | 500 | 3949 | 500 |
| 3546 | 500 | 3993 | 500 |
| 3561 | 500 | 3999 | 500 |

Source: U.S. Small Business Administration. Size Standards by SIC Industry. 1996. Available
 <<http://www.sba.govgopher/Government-Contracting/Size/sizeall.txt>>.

SECTION 3

ENGINEERING COST ANALYSIS

During the production of RPCs, a portion of the monomers (i.e., styrene, methyl methacrylate) used to transform plastic resin into a durable product are released into the environment. To control these emissions, EPA has developed national emission standards for these HAPs under the authority of Section 112 of the CAA. This section presents the Agency's estimates of the national compliance costs associated with three regulatory alternatives developed to reduce HAP emissions. A detailed discussion of the methodologies used to develop these estimates is provided in the BID.

3.1 Identifying Regulated Entities

Based on information provided from EPA's 1993 survey of the reinforced plastics industry, 433 facilities were determined to be potential major sources of HAP emissions from the production of reinforced plastics. Ohio, Indiana, California, Texas, and Pennsylvania are the top five states in order of number of major source facilities. Based on available data on firm ownership, 302 facilities (69 percent) are owned by small businesses. Additional information on these facilities and their ownership is provided in Section 2.

3.2 National Control Cost Estimates

The Agency developed facility-specific estimates of annual compliance costs for each of the following three regulatory alternatives:

- the MACT floor applied to all existing sources,
- above-the-floor controls applied to all sources, and
- the recommended alternative that applies control costs as follows:
 - ✓ sources that emit *less than 100 tons* of HAPs per year—MACT floor controls;
 - ✓ sources owned by small firms (as classified by the SBA definitions) that emit *less than 250 tons* of HAPs per year—MACT floor controls; and

- ✓ sources owned by large firms (as classified by SBA definitions) that emit more than 100 tons of HAP per year—above-the-floor controls.

The engineering analysis provided estimates of total annual compliance costs associated with the required pollution control equipment or less pollution intensive method that brings each facility into compliance with the proposed standards. Note, however, that this cost estimate does not account for behavioral responses (i.e. changes in price and output rates). Instead these estimates are inputs to the economic model as described in Section 4 and include the following:

- the capital costs associated with new control equipment as appropriately annualized over the equipment lifetime at a 7 percent discount rate, and
- variable costs associated with the operation maintenance of pollution control equipment, cost of energy required to operate control equipment, materials replacement costs (replacement of existing resins/gelcoats with a low HAP resin/gel coat), and other administrative costs associated with monitoring, recordkeeping, and reporting.

The nationwide compliance cost estimates for the required controls under each regulatory alternative are as follows:¹

- recommended alternative—\$26.1 million;
- MACT floor—\$16.3 million; and
- above-the-MACT floor—\$67.4 million.

¹All dollar amounts are expressed in \$1997.

SECTION 4

ECONOMIC IMPACT ANALYSIS

The proposed NESHAP requires producers of RPCs that use selected thermosetting resins to meet emission standards for releases of HAPs to the atmosphere. To meet these standards, most producers will have to install equipment designed to capture pollutants now released to the environment or to change production to less pollution-intensive methods. These actions will have financial implications for the affected producers. They will have broader societal implications because these effects are transmitted through market relationships to other producers and consumers. These potential economic impacts are the subject of this section.

EPA is examining three regulatory alternatives for addressing the problem of HAP releases from these sources:

- 1) the MACT floor applied to all sources,
- 2) above-the-floor controls applied to all sources, and
- 3) the recommended alternative that applies control costs as follows:
 - sources that emit *less than 100 tons* of HAPs per year—MACT floor controls;
 - sources owned by small firms (as classified by the SBA definitions) that emit *less than 250 tons* of HAP per year—MACT floor controls; and
 - sources owned by large firms (as classified by SBA definitions) that emit more than 100 tons of HAP per year—above-the-floor controls.

This section provides results for each alternative.

To measure the size and distribution of the economic impacts of these alternatives, EPA compared baseline conditions of RPC markets in 1997 with those for the counterfactual or with-regulation conditions expected to result from implementing each alternative. The main elements of this analysis are

- identification of markets for RPC products and description of firm behavior within these markets;
- economic characterization of the regulated facilities in terms of whether they are a commercial or captive producer, commodity produced, and cost of production;
- characterization of baseline demand for each product;
- development of an economic model that evaluates behavioral responses to additional costs of regulation in a market context; and
- presentation and interpretation of economic impact estimates developed by the model.

4.1 Reinforced Plastic Composite Markets

RPCs are consumed as inputs in the production of a wide variety of products that can be found within the following broad market segments:

- Aircraft/Military: flight surfaces, cabin interiors, aerospace components, military helmets, armament, rocket launchers, etc.
- Appliance/Business: refrigerators, freezers, ranges, microwave ovens, power tools, small appliances, computer housings, calculators, etc.
- Construction: swimming pools, rain gutters, molds for concrete, bathtubs, shower stalls, whirlpools, spas, highway signs, cooling tower components, paneling for greenhouses, patios, railings and other architectural components
- Consumer Products: fishing rods, golf clubs, skis, tennis rackets, furniture, campers, snowmobiles, exercise equipment, seating, counter tops, serving trays, boxes and containers, microwave cookware, etc.
- Corrosion Resistant Products: pipe fittings, ducts, hoods, tanks, pumps, filtration equipment, and a wide variety of other chemical resistant products for use in the waste/wastewater treatment, chemical processing, semiconductor, and petrochemical industries
- Electronic/Electrical: rods, tubes, circuit breaker boxes, molded parts, housings, substation equipment, electronic connections, pole line hardware, microwave antennas, and many other electrical and electronic applications
- Land Transportation: body panels for cars, buses, and tractor trailers, truck cabs, boxcar doors, subway seating, heater housings, front end assemblies, drive shafts, wind deflectors, grill opening panels, tail light housings, fender liners, instrument

panels, and other diverse parts and accessories for land transportation and utility vehicles

- Other: all other composites applications, including the repair/replacement of components of the civil infrastructure such as guardrails, sign posts, and structural supports for highways and bridges

Some of the directly affected operations are performed as part of larger integrated process. These captive producers do not engage in commercial transactions involving the RPC product. They produce and sell a product (e.g., appliances) that incorporates the RPC product that they also produce. Other RPC producers do sell their products in the market where the RPC product is used as an input to another product, which also could be appliance manufacture. Presumably, each producer has conducted a “make or buy” decision, some deciding to buy the RPC commodity, others to self-produce it.

Each of the product groups above is taken as a separate composite commodity with a single price and unique supply and demand characterization. In addition to these segments, sufficient market information is available to separate the construction segment into three distinct end-use markets—general construction, plumbing fixtures, and panels. Operating at this broad level of product aggregation when there are literally thousands of specific products obviously masks baseline price differences and market shifts within each segment. However, without substantial additional data further disaggregation is not possible.

As shown in Table 4-1, more than 3.1 billion pounds of RPC products were shipped in 1997 to domestic and foreign consumers in these markets. Based on industry survey responses and historical average growth rates, EPA estimated that 1.4 billion pounds of RPCs, or 45 percent of the total shipments, were manufactured by facilities directly affected by the regulation. Facilities using unaffected resins (i.e., thermoplastics or unaffected thermosets) produced 1.7 billion pounds of RPCs.

Both segments include “in-house” production of RPCs by captive facilities and merchant production by commercial RPC suppliers. The captive facilities are likely to be owned by larger integrated firms manufacturing durable products, while the commercial facilities are typically smaller specialty firms. Given limited data on the type of facility, the Agency approximated this distribution by using the SBA criteria for large and small businesses. In the directly affected segment, facilities owned by large businesses are assumed to be captively owned and operated. Facilities owned by small businesses are assumed to be

Table 4-1. Reinforced Plastics Composites Shipments by End-Use Market: 1997
(10⁶ lbs)^a

| End-Use Market | Total | Directly Affected ^b | | Indirectly Affected ^c | |
|------------------------------|--------------------|--------------------------------|---------|----------------------------------|---------|
| | | Merchant | Captive | Merchant | Captive |
| Aircraft/aerospace | 24.0 | 0.5 | 5.3 | 1.6 | 16.6 |
| Appliances/business equip. | 185.0 | 12.0 | 8.5 | 96.1 | 68.4 |
| General construction | 163.5 ^d | 44.6 | 71.9 | 18.0 | 29.0 |
| Plumbing fixtures | 403.3 | 172.7 | 230.6 | 0.0 | 0.0 |
| Panels | 202.6 ^d | 22.7 | 100.7 | 14.5 | 64.6 |
| Consumer products | 210.0 | 31.0 | 56.0 | 43.8 | 79.2 |
| Corrosion-resistant products | 396.0 | 120.7 | 30.9 | 194.5 | 49.9 |
| Electrical/electronic | 348.0 | 18.0 | 81.2 | 45.2 | 203.6 |
| Land transportation | 1,095.0 | 112.2 | 255.2 | 222.2 | 505.4 |
| Miscellaneous | 111.0 | 21.3 | 19.3 | 36.9 | 33.4 |
| Total | 3,138.4 | 555.6 | 859.8 | 672.9 | 1,050.1 |

^a Includes weight of resin, reinforcements, and fillers. Totals may not sum due to independent rounding.

^b Estimates based on projected facility data developed from ICR survey responses and historical average annual output rates. The merchant/captive distribution was determined by the size of the owning company (i.e., large = captive and small = merchant).

^c Computed as the difference between total shipments and directly affected shipments. Merchant/captive quantities were calculated using the same merchant/ captive ratio observed for the affected segment.

^d EPA estimate.

Source: Society of Plastics Industry, Inc. 1998. *Facts and Figures of the U.S. Plastic Industry. 1998 Edition*. SPI, Washington, DC: September 1998.

merchant producers. For the unaffected segment, the Agency computed the merchant/captive distribution using the ratio observed for the regulated segment.

Following the above approach, EPA estimated that 555.6 million pounds of regulated thermoset RPCs were exchanged in markets during 1997, or 39 percent of the directly affected segment of 1,415.4 million pounds. Captively produced resins that are directly affected by the regulation accounted for the remaining 859.8 million pounds. As shown in Table 4-1, the same merchant/captive proportions are applied to the indirectly affected segment. The directly and indirectly affected merchant supply then constitutes the market quantity for each RPC product as shown in Table 4-2.

Publicly available data on market prices for RPCs at this level of aggregation does not exist. Absent these data, EPA computed market prices for each market segment by taking the

Table 4-2. Estimated Market Quantities and Prices for Reinforced Plastics Composites by Product Group: 1997

| Product Group | Quantity (10 ⁶ lbs/yr) | | | Price (\$/lb) ^a |
|------------------------------|-----------------------------------|---------------------|--------------|----------------------------|
| | Directly Affected | Indirectly Affected | Total Market | |
| Aircraft/aerospace | 0.51 | 1.57 | 02.08 | \$38.35 |
| Appliances/business equip. | 11.98 | 96.11 | 108.09 | \$2.37 |
| General construction | 44.61 | 17.99 | 62.59 | \$3.46 |
| Plumbing fixtures | 172.66 | 0.00 | 172.66 | \$3.48 |
| Panels | 22.67 | 14.55 | 37.23 | \$3.24 |
| Consumer products | 30.95 | 43.77 | 74.72 | \$3.41 |
| Corrosion-resistant products | 120.66 | 194.47 | 315.13 | \$3.77 |
| Electrical/electronic | 18.04 | 45.23 | 63.27 | \$3.29 |
| Land transportation | 112.22 | 222.22 | 334.44 | \$3.44 |
| Miscellaneous | 21.34 | 36.95 | 58.29 | \$3.41 |
| Totals/Average | 555.64 | 672.86 | 1,228.50 | \$3.48 |

^a Computations based on multiplying the per-unit estimates of the facility-specific costs of materials (i.e., resins, fillers, and reinforcements) by the U.S. Census estimate of the average ratio of sales to costs-of-materials for NAICS code 326199A (reinforced and fiberglass plastics products, nec), which was 2.28. The unit cost of the highest cost supplier in each market was assumed to be equal to the commodity price for that market segment.

highest values that result from the multiplication of the facility-specific costs of materials (i.e., resins, fillers, and reinforcements)¹ by the U.S. Census Bureau estimate of the average ratio of sales to costs-of-materials for NAICS code 326199A (reinforced and fiberglass plastics products, nec), which was 2.28. Assuming perfect competition for this analysis, the resulting sales estimate is deemed as the best approximation of facility-specific pricing with the highest (or marginal) supplier in each market determining market price. Table 4-2 presents the estimated prices for RPCs in 1997 for each RPC product grouping as well as the directly and indirectly affected market quantities.

¹Given the limited data on use of these materials by market, the Agency computed a weighted average price (\$1.00 per pound resin, \$1.25 per pound reinforcement, and \$0.09 per pound for filler) and applied it to estimate material costs for each producer with the exception of aerospace/military. In that case, EPA used data on carbon reinforcement prices only.

Market impacts of the regulation are conditional on the behavior of firms. For this analysis, firms are viewed as price-takers; that is, each firm takes the market price as given. This assumption of “perfect competition” seems appropriate given the number and distribution of buyers and sellers of RPCs across the United States and the reasonably homogeneous nature of RPC products. Therefore, the Agency modeled ten national, perfectly competitive markets based on the product groups identified above.

4.2 Producers, Costs, and Supply

As described above, RPC facilities are classified into two types of producers: captive or merchant. Several factors would suggest that the impact of the regulation on the choices of captive producers (i.e., the use of “in-house” RPCs production methods, substitute materials, and RPC output levels) is small because RPCs typically represent a small cost share of their final products. In addition, quality and control issues may preclude these operations from obtaining RPCs from outside suppliers. Therefore, the market analysis focuses only on the merchant segment of RPC production.

Two types of merchant suppliers operate in these markets:

- facilities directly affected by the regulation because they face additional costs with the implementation of the NESHAP and
- facilities indirectly affected by the regulation because they produce a close substitute for the products produced by the regulated entities.

Although this second type of supplier does not incur additional control costs, it will be affected by any changes in market prices that occur with the regulation. The engineering analysis projected each directly affected facility’s 1997 product-line quantities based on the Information Collection Request (ICR) survey data and historical industry average annual output growth rates. Each individual merchant facility is included in the economic model. The output from indirectly affected producers is the difference between total merchant shipments produced and that from affected producers (see Table 4-1). Absent a detailed characterization of these producers and because they are not subject to the regulation, this component of supply was included in the economic model as a single representative supplier with a general functional form that allows for increases in their production in response to price increases (see Appendix B for details).

For affected facilities, the Agency developed unit cost curves for each RPC product line based on the reported production and the associated market price from Table 4-2 (see

Appendix B for details). Given fixed factors of production (i.e., plant and equipment), each RPC product line at a directly affected facility is characterized by an upward-sloping supply function, as shown in Figure 4-1. In this case, the supply function is that portion of the marginal cost curve bounded by zero and the technical capacity at the facility with production costs being measured as the area under the curve up to their output level. Suppliers select their output level according to this schedule as long as the market price is sufficiently high to cover average variable costs (i.e., greater than C_0 in Figure 4-1) and the resulting revenue surplus is large enough to cover any fixed costs. If the market price falls below the minimum average variable costs, then the firm's best response is to cease production because total revenue does not cover the total variable costs of production. These individual supply decisions are then aggregated (i.e., horizontally summed) to develop the market supply curve. Once we apply this characterization of the supply function to each affected producer, we derive their production costs by taking the integral of the area under the curve corresponding to their production rate and market price.

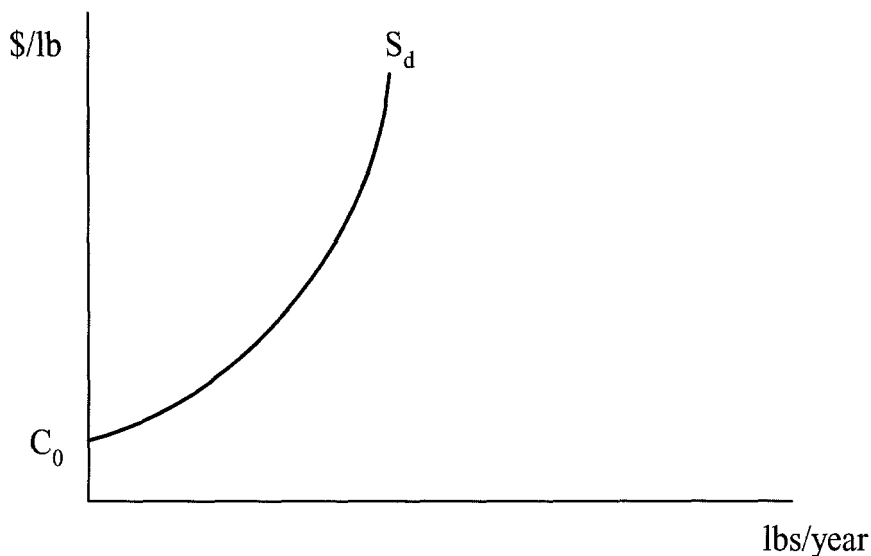


Figure 4-1. Supply Curve for a Representative Directly Affected Merchant Facility

As detailed in Appendix B, this analysis employs an “intermediate” run analysis in which some factors are fixed (capital) and others are variable (labor, materials, etc.). This allows us to avoid the consequences of assuming the very short run or the long run. The very short run is a case in which all factors of production are fixed and producers are unable to respond and, thus, incur a one-to-one reduction in profits due to regulation, while the long run is a case in which all factors are variable and all regulatory costs are passed on to consumers. Therefore, our modeling approach addresses economic viability for both the short-run criteria (i.e., product-line revenues cover all variable costs) and the long-run criteria (i.e., facility revenues cover total costs).

4.3 Consumers, Value, and Demand

Two types of consumers use RPC products:

- “in-house” consumers of RPCs produced by captive producers, and
- other firms that purchase RPCs from merchant producers.

Large integrated firms consume RPCs manufactured within the firm, and no explicit RPC demand is revealed through a market transaction. Rather, the decision to consume RPCs produced “in-house” is the result of a “make or buy” decision that considers the value to the firm of manufacturing these inputs as opposed to purchasing them offsite. Although these choices are not explicitly addressed in the economic model, it is likely that these consumers are less responsive to changes in RPC costs because the cost share of total production is small and their supply options may be limited for corporate or technical reasons. As a result, the impacts on these producers are determined using a full-cost absorption approach with the estimated regulatory costs causing a dollar for dollar reduction in their profits.

A variety of consumers purchase RPC products commercially and incorporate them into other higher-order products. For example, automobile manufacturers use RPC bumpers and interior components; electrical appliances and electronic products use RPCs as internal components and external housings. The value of these products depends on the availability and cost of substitution for the product (i.e., metal instead of plastic), the features of the alternative product that affect its degree of substitutability in higher-order products, and the price of the higher-order product.

For the economic analysis, each commodity market was modeled as having a single aggregate consumer with a downward-sloping market demand curve (see Figure 4-2). The

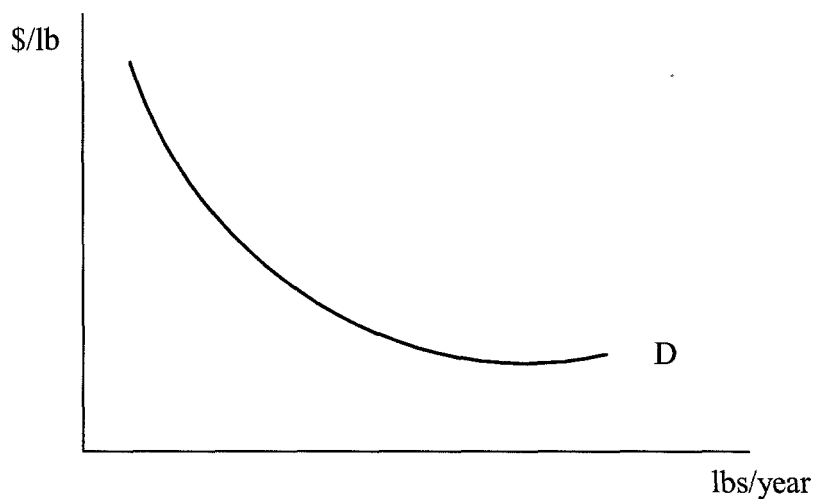


Figure 4-2. Demand Curve for RPCs

Agency constructed this curve for each RPC commodity using baseline quantity, price data, and assumptions about the responsiveness to changes in price (derived demand elasticity). Factors that influence the magnitude of this price responsiveness include the

- price-responsiveness of the end product made with RPCs,
- cost share of the RPC input in total production of the end product, and
- ease of substitution between this input and other inputs in production.

Although data limitations prevent estimation of these parameters, knowledge about the relationships of these factors makes it possible to develop informed assumptions about RPC consumer responsiveness to price changes in commercial markets. If we assume or expect that the

- demand elasticity of the final commodity is one (i.e., a 1 percent increase in price results in a 1 percent decrease in quantity demanded),
- cost share of RPCs in total production cost is small, and
- ease of substitution between inputs difficult, then

the elasticity of demand for RPCs would be inelastic (i.e., less than one). For this analysis, the Agency used a demand elasticity of -0.5 (i.e., a 1 percent increase/decrease in the price of RPCs would result in a 0.5 percent decrease/increase in the quantity of RPC products demanded). Appendix B provides a detailed description of the equations that characterize the market demand curves.

4.4 Baseline and With-Regulation Equilibrium

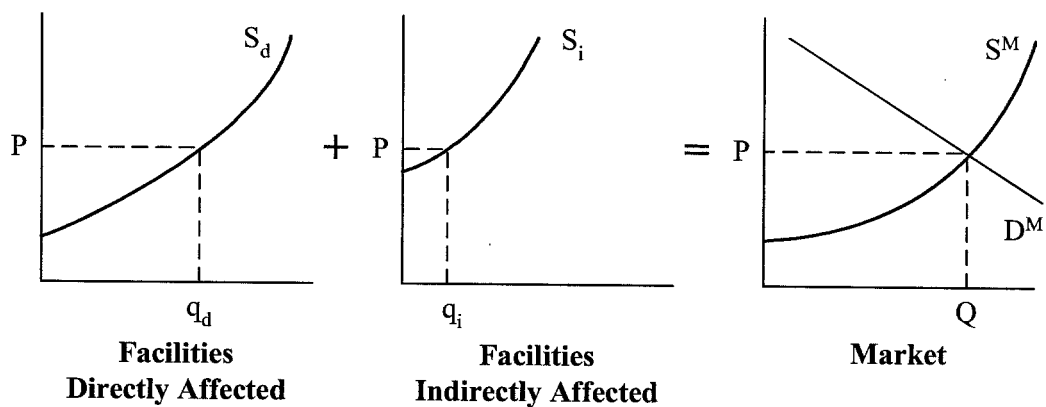
The competitive model of price formation, as shown in Figure 4-3 (a), posits that market prices and quantities are determined by the intersection of the market supply and demand curves. Under the baseline scenario, a market price and quantity (P, Q) are determined by the downward-sloping market demand curve (D^M) and the upward-sloping market supply curve (S^M) that reflects the sum of the individual supply curves of directly affected and indirectly affected facilities that produce a given product.

With the regulation, the cost of production increases for suppliers using regulated thermoset resins. These additional costs include a variable component consisting of the operating and maintenance costs and a fixed component that does not vary with output (i.e., expenditures for control-related capital equipment to comply with the regulatory alternative). The imposition of the regulatory control costs is represented as an upward shift in the supply curve for each directly affected facility. As a result of the upward shift in these individual supply curves, the market supply curve for RPC products will shift upward as shown in Figure 4-3(b) to reflect the increased costs of production at facilities using thermoset resins.

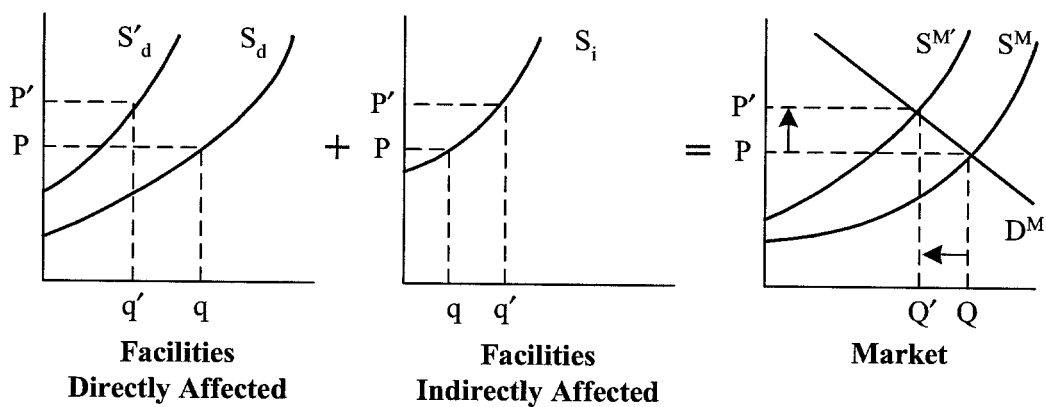
In baseline without the proposed standards, the industry produces total output, Q , at price, P , with directly affected facilities producing the amount q_d and indirectly affected facilities accounting for Q minus q_d , or q_i . With the regulation, the market price increases from P to P' and market output (as determined from the market demand curve, D^M) declines from Q to Q' . This reduction in market output is the net result of reductions at directly affected facilities and increases at indirectly affected facilities.

4.5 Results

The simple analytics presented above suggest that, when faced with higher costs of RPC product production, producers will attempt to mitigate their impacts by making adjustments to shift as much of the burden on other economic agents as market conditions allow. The adjustments available to facility operators include changing production processes, changing inputs, changing output rates, or even closing the facility. This analysis focuses on



a) Baseline Equilibrium



b) With-Regulation Equilibrium

Figure 4-3. Market Equilibrium Without and With Regulation

the last two options because they appear to be the most viable for RPC facilities, at least in the near-term. A large segment of the RPC industry is affected by the regulation, and we would expect upward pressure on prices as producers facing higher costs reduce output rates in response to these costs. Changes in market prices and, through the impact of price on

quantity demanded, output for each product will lead to changes in the profitability of product lines, facilities, and firms. These market and industry adjustments will also determine the social costs of the regulation.

To estimate these economic impacts, the conceptual model described above was operationalized in a multiple spreadsheet model, as detailed in Appendix B. In summary, this model characterizes producers and consumers of each RPC product and their behavioral responses to the imposition of the regulatory compliance costs. These costs are expressed per pound of RPC product for each facility and serve as the input to the market model, or “cost-shifters” of the baseline supply curves at the facility. Given these costs for directly affected facilities, the model determines a new equilibrium solution in a comparative static approach with higher market prices and reductions in output for each RPC product.

The following sections provide the Agency’s estimates of these economic impacts for the recommended alternative and compare and contrast these results with the projected impacts under the MACT floor and above-the-MACT floor alternatives.

4.5.1 Market-Level Impacts

The increased cost of production due to the regulation is expected to slightly increase the price of composites and marginally reduce their production/consumption from baseline levels. As shown in Table 4-3, the recommended alternative is projected to increase the average price of RPC products by 0.3 percent, or \$0.01 per pound. The price impacts are attenuated by the existence of a perfect substitute for the regulated RPC products. This substitute is RPC products made from thermoplastic resins, which are not subject to the regulation. With higher RPC product prices, they are expected to increase production by 0.3 percent. The combined effect of higher costs due to regulation and substitution to unaffected RPC products is expected to cause a 0.8 percent reduction in production at regulated facilities. The net result of these reductions at affected facilities and the increases at unaffected facilities is a market decline in output of 0.2 percent.

The size of the projected price increase for each commodity is primarily determined by the level and distribution of compliance costs incurred by the facilities manufacturing these commodities. In general, markets with higher per-unit compliance costs are expected to experience the most significant price changes. As shown in Table 4-4, market prices are projected to increase at or above the industry average for five of the ten markets. An additional factor in determining the changes in market prices across the products is the

Table 4-3. Market-Level Impacts of the Reinforced Plastic Composites NESHAP Regulatory Alternatives: 1997

| | Baseline | MACT Floor | | Recommended Alternative | | Above-the-MACT-Floor | |
|---|----------|-----------------|-----------------|-------------------------|-----------------|----------------------|-----------------|
| | | Absolute Change | Relative Change | Absolute Change | Relative Change | Absolute Change | Relative Change |
| Aircraft/Aerospace | | | | | | | |
| Market Price (per lb) | \$38.35 | <\$0.01 | <0.1% | <\$0.01 | <0.1% | \$0.01 | <0.1% |
| Market Quantity (Millions lbs/yr) | 2.08 | <-0.01 | <-0.1% | <-0.01 | <-0.1% | <-0.01 | <-0.1% |
| Thermosets (Directly Affected) | 0.51 | <-0.01 | <-0.1% | <-0.01 | <-0.1% | <-0.01 | <-0.1% |
| Thermosets/Thermoplastics (Indirectly Affected) | 1.57 | <0.01 | <0.1% | <0.01 | <0.1% | <0.01 | <0.1% |
| Appliances/Business Equipment | | | | | | | |
| Market Price (per lb) | \$2.37 | <\$0.01 | <0.1% | <\$0.01 | <0.1% | <\$0.01 | 0.2% |
| Market Quantity (Millions lbs/yr) | 108.09 | -0.02 | <-0.1% | -0.02 | <-0.1% | -0.12 | -0.1% |
| Thermosets (Directly Affected) | 11.98 | -0.07 | -0.6% | -0.07 | -0.6% | -0.33 | -2.7% |
| Thermosets/Thermoplastics (Indirectly Affected) | 96.11 | 0.04 | <0.1% | 0.04 | <0.1% | 0.21 | 0.2% |
| General Construction | | | | | | | |
| Market Price (per lb) | \$3.46 | \$0.02 | 0.5% | \$0.02 | 0.5% | \$0.06 | 1.7% |
| Market Quantity (Millions lbs/yr) | 62.59 | -0.21 | -0.2% | -0.22 | -0.2% | -0.52 | -0.6% |
| Thermosets (Directly Affected) | 44.61 | -0.43 | -1.0% | -0.43 | -1.0% | -1.29 | -2.9% |
| Thermosets/Thermoplastics (Indirectly Affected) | 17.98 | 0.21 | 0.5% | 0.21 | 0.5% | 0.77 | 1.7% |
| Plumbing Fixtures | | | | | | | |
| Market Price (per lb) | \$3.48 | \$0.01 | 0.3% | \$0.01 | 0.3% | \$0.05 | 1.5% |
| Market Quantity (Millions lbs/yr) | 172.66 | -0.29 | -0.2% | -0.29 | -0.2% | -1.28 | -0.7% |
| Thermosets (Directly Affected) | 172.66 | -0.29 | -0.2% | -0.29 | -0.2% | -1.28 | -0.7% |
| Thermosets/Thermoplastics (Indirectly Affected) | — | — | NA | — | NA | — | NA |
| Panels | | | | | | | |
| Market Price (per lb) | \$3.24 | <\$0.01 | 0.1% | <\$0.01 | 0.1% | \$0.01 | 0.2% |
| Market Quantity (Millions lbs/yr) | 37.23 | -0.04 | -0.1% | -0.04 | -0.1% | -0.06 | -0.1% |
| Thermosets (Directly Affected) | 22.67 | -0.08 | -0.3% | -0.08 | -0.3% | -0.12 | -0.5% |
| Thermosets/Thermoplastics (Indirectly Affected) | 14.55 | 0.04 | 0.1% | 0.04 | 0.1% | 0.07 | 0.2% |
| Consumer Products | | | | | | | |
| Market Price (per lb) | \$3.41 | \$0.01 | 0.4% | \$0.01 | 0.4% | \$0.03 | 1.0% |
| Market Quantity (Millions lbs/yr) | 74.72 | -0.17 | -0.2% | -0.17 | -0.2% | -0.46 | -0.5% |
| Thermosets (Directly Affected) | 30.95 | -0.39 | -1.3% | -0.39 | -1.3% | -1.07 | -3.5% |
| Thermosets/Thermoplastics (Indirectly Affected) | 43.77 | 0.22 | 0.4% | 0.22 | 0.4% | 0.61 | 1.0% |

(continued)

**Table 4-3. Market-Level Impacts of the Reinforced Plastic Composites NESHAP Regulatory Alternatives: 1997
(continued)**

| | Baseline | MACT Floor | | Recommended Alternative | | Above-the-MACT-Floor | |
|---|----------|-----------------|-----------------|-------------------------|-----------------|----------------------|-----------------|
| | | Absolute Change | Relative Change | Absolute Change | Relative Change | Absolute Change | Relative Change |
| Corrosion-Resistant | | | | | | | |
| Market Price (per lb) | \$3.77 | \$0.02 | 0.4% | \$0.02 | 0.4% | \$0.04 | 1.1% |
| Market Quantity (Millions lbs/yr) | 315.13 | -0.78 | -0.2% | -0.78 | -0.2% | -1.92 | -0.6% |
| Thermosets (Directly Affected) | 120.66 | -1.77 | -1.5% | -1.77 | -1.5% | -4.38 | -3.6% |
| Thermosets/Thermoplastics (Indirectly Affected) | 194.47 | 0.99 | 0.4% | 0.99 | 0.4% | 2.46 | 1.1% |
| Electrical/Electric | | | | | | | |
| Market Price (per lb) | \$3.29 | <\$0.01 | 0.1% | <\$0.01 | 0.1% | \$0.01 | 0.2% |
| Market Quantity (Millions lbs/yr) | 63.27 | -0.04 | <-0.1% | -0.04 | <-0.1% | -0.09 | -0.1% |
| Thermosets (Directly Affected) | 18.04 | -0.09 | -0.5% | -0.09 | -0.5% | -0.23 | -1.3% |
| Thermosets/Thermoplastics (Indirectly Affected) | 45.23 | 0.05 | 0.1% | 0.05 | 0.1% | 0.14 | 0.2% |
| Land Transportation | | | | | | | |
| Market Price (per lb) | \$3.44 | \$0.01 | 0.3% | \$0.01 | 0.3% | \$0.02 | 0.7% |
| Market Quantity (Millions lbs/yr) | 334.44 | -0.55 | -0.1% | -0.55 | -0.1% | -1.46 | -0.4% |
| Thermosets (Directly Affected) | 112.22 | -1.34 | -1.2% | -1.34 | -1.2% | -3.58 | -3.2% |
| Thermosets/Thermoplastics (Indirectly Affected) | 222.22 | 0.78 | 0.3% | 0.78 | 0.3% | 2.11 | 0.7% |
| Miscellaneous | | | | | | | |
| Market Price (per lb) | \$3.41 | \$0.01 | 0.2% | \$0.01 | 0.2% | \$0.03 | 0.9% |
| Market Quantity (Millions lbs/yr) | 58.29 | -0.09 | -0.1% | -0.09 | -0.1% | -0.32 | -0.5% |
| Thermosets (Directly Affected) | 21.34 | -0.20 | -0.9% | -0.20 | -0.9% | -0.75 | -3.5% |
| Thermosets/Thermoplastics (Indirectly Affected) | 36.95 | 0.11 | 0.2% | 0.11 | 0.2% | 0.43 | 0.9% |
| Total | | | | | | | |
| Market Price (per lb) | \$3.48 | \$0.01 | 0.3% | \$0.01 | 0.3% | \$0.03 | 0.9% |
| Market Quantity (Millions lbs/yr) | 1,228.50 | -2.20 | -0.2% | -2.20 | -0.2% | -6.23 | -0.4% |
| Thermosets (Directly Affected) | 555.64 | -4.66 | -0.8% | -4.66 | -0.8% | -13.04 | -2.3% |
| Thermosets/Thermoplastics (Indirectly Affected) | 672.86 | 2.46 | 0.3% | 2.46 | 0.3% | 6.81 | 0.8% |

Table 4-4. Summary of Compliance Costs and Market Price Changes: 1997 (\$/lb)

| | Directly Affected Share | MACT Floor | | | Recommended Alternative | | | Above-the-MACT-Floor | | |
|-------------------------------|-------------------------|-----------------------------|--------|---------------------|-----------------------------|--------|---------------------|-----------------------------|---------|---------------------|
| | | Incremental Compliance Cost | | Market Price Change | Incremental Compliance Cost | | Market Price Change | Incremental Compliance Cost | | Market Price Change |
| | | Mean | Max | Absolute Relative | Mean | Max | Absolute Relative | Mean | Max | Absolute Relative |
| Aircraft/Aerospace | 25% | \$0.03 | \$0.03 | NA | \$0.03 | \$0.03 | <\$0.01 | \$0.24 | \$0.24 | \$0.01 |
| Appliances/Business Equipment | 11% | \$0.02 | \$0.06 | \$0.03 | \$0.02 | \$0.06 | <\$0.01 | \$0.12 | \$0.36 | <\$0.01 |
| General Construction | 71% | \$0.06 | \$0.38 | \$0.07 | \$0.06 | \$0.38 | \$0.02 | \$0.34 | \$1.45 | \$0.06 |
| Plumbing Fixtures | 100% | \$0.07 | \$4.22 | \$0.44 | \$0.07 | \$4.22 | \$0.01 | \$0.92 | \$69.27 | \$0.05 |
| Panels | 61% | \$0.02 | \$0.15 | \$0.04 | \$0.02 | \$0.15 | <\$0.01 | \$0.13 | \$0.85 | \$0.01 |
| Consumer Products | 41% | \$0.07 | \$0.29 | \$0.08 | \$0.07 | \$0.29 | \$0.01 | \$0.46 | \$3.26 | \$0.03 |
| Corrosion-Resistant | 38% | \$0.09 | \$0.45 | \$0.12 | \$0.09 | \$0.45 | \$0.02 | \$0.37 | \$2.46 | \$0.04 |
| Electrical/Electric | 29% | \$0.03 | \$0.15 | \$0.04 | \$0.03 | \$0.15 | <\$0.01 | \$0.17 | \$0.92 | \$0.01 |
| Land Transportation | 34% | \$0.07 | \$0.28 | \$0.05 | \$0.07 | \$0.28 | \$0.01 | \$0.35 | \$1.66 | \$0.02 |
| Miscellaneous | 37% | \$0.06 | \$0.16 | \$0.05 | \$0.06 | \$0.16 | \$0.01 | \$0.32 | \$1.33 | \$0.03 |
| Total | 45% | \$0.07 | \$4.22 | \$0.19 | \$0.07 | \$4.22 | \$0.01 | \$0.52 | \$69.27 | \$0.03 |

NA: Not applicable. Only one facility is affected in this market.

market share of substitute products (i.e., thermoplastic RPCs). As discussed above, suppliers of these products are expected to limit the ability of affected producers to increase prices in these markets. As shown in Table 4-4, the price increases in markets where these suppliers account for greater shares of total output are less than those markets with a smaller presence of these suppliers. The general construction market shows the highest percentage increases in prices (0.5 percent) because they have higher average per-unit compliance costs (\$0.06 per pound) and a high market share of affected products (71 percent).

The other regulatory alternatives have similar directional effects on price and quantity (i.e., higher price, declines in output). The expected price and quantity adjustments under the recommended and MACT floor alternatives are very similar because many of these facilities emit less than 100 tons of HAPs annually and, as a result, do not require the above-the-floor controls under the recommended alternative. However, subjecting all facilities to the above-the-MACT floor alternative is projected to heighten the increase in RPC market prices (i.e., 0.9 percent increase vs. 0.3 percent under the recommended alternative) and the decline in market quantity (i.e., 0.4 percent decline vs. 0.2 percent under the recommended alternative). Furthermore, the above-the-MACT floor alternative shows greater displacement of market production with affected producers reducing output by 2.3 percent as opposed to the 0.8 percent decline projected under the recommended alternative.

4.5.2 Industry-Level Impacts

Industry revenues, costs, and profitability change as RPC prices and production levels adjust to the imposition of the regulation. As a result of these changes, the recommended alternative is projected to decrease RPC industry pre-tax earnings by \$12 million (see Table 4-5). In addition, 29 facilities and 73 product lines are projected to close with the rule, and the losses in employment attributable to the rule total 809 employees. The less stringent MACT floor alternative projects similar results, while the economic impacts of the more stringent alternative are significantly higher. The following sections discuss these industry-level impacts in detail with additional emphasis on the rule's distributional impacts.

4.5.2.1 Changes in Pre-Tax Earnings

The projected change in pre-tax earnings is the net result of changes for directly and indirectly affected merchant facilities plus changes for directly affected captive facilities. After accounting for market adjustments, the directly affected merchant producers are

Table 4-5. Industry-Level Impacts of Reinforced Plastic Composites NESHAP Regulatory Alternatives: 1997

| | Baseline | MACT Floor | | Recommended Alternative | | Above-the-MACT-Floor | |
|---|----------|-----------------|-------------------|-------------------------|-------------------|----------------------|-------------------|
| | | Absolute Change | Percentage Change | Absolute Change | Percentage Change | Absolute Change | Percentage Change |
| Merchant Thermoset Producers (Directly Affected) | | | | | | | |
| Revenues (\$10 ⁶ /yr) | \$1,957 | -\$10 | -0.5% | -\$10 | -0.5% | -\$22 | -1.1% |
| Costs (\$10 ⁶ /yr) | \$1,869 | -\$9 | -0.5% | -\$9 | -0.5% | -\$14 | -0.7% |
| Compliance | --- | \$7 | NA | \$7 | NA | \$28 | NA |
| Production | \$1,869 | -\$16 | -0.8% | -\$16 | -0.8% | -\$42 | -2.2% |
| Pre-tax earnings (\$10 ⁶ /yr) | \$87 | -\$1 | -0.7% | -\$1 | -0.7% | -\$8 | -9.8% |
| Operating Entities | | | | | | | |
| Product Lines | 471 | -73 | 15.5% | -73 | 15.5% | -162 | 34.4% |
| Facilities | 299 | -29 | -9.7% | -29 | -9.7% | -90 | -30.1% |
| Employment | 18,223 | -900 | -4.9% | -900 | -4.9% | -2,285 | -12.5% |
| Captive Thermoset Producers | | | | | | | |
| Pre-tax earnings (\$10 ⁶ /yr) ^a | NA | -\$9 | NA | -\$18 | NA | -\$31 | NA |
| Employment ^b | 20,263 | NA | NA | NA | NA | NA | NA |
| Thermoset/Thermoplastic Producers (Indirectly Affected) | | | | | | | |
| Pre-tax earnings (\$10 ⁶ /yr) | NA | \$7 | NA | \$7 | NA | \$21 | NA |
| Employment | 30,668 | 91 | 0.3% | 91 | 0.3% | 265 | 0.9% |
| All Producers | | | | | | | |
| Pre-tax earnings (\$10 ⁶ /yr) | NA | -\$1 | NA | -\$12 | NA | -\$19 | NA |
| Employment | 69,153 | -809 | -1.2% | -809 | -1.2% | -2,021 | -2.9% |

^a Change in profit is equal to the engineering cost estimate.

^b Although these producers incur compliance costs, EPA did not project changes in employment.

expected to incur \$7 million annually in regulatory compliance costs. As shown in Table 4-5, based on projected individual and market responses, the economic analysis estimates the net effect of revenue and cost changes for these producers to result in a decline in pre-tax earnings of \$1 million per year. This reduction in profits is less than the regulatory costs they incur because these producers reduce their production, resulting in higher market prices for each RPC product, which effectively shifts a portion of the regulatory burden onto consumers.

As shown in Table 4-5, unaffected merchant producers increase their production in response to the higher market prices and, thereby, experience gains in pre-tax earnings of \$7 million per year. Thus, the aggregate increase in merchant industry profits of \$6 million is a result of the net change in profits at affected and unaffected merchant producers, thereby highlighting an important distributional impact of this rule that unaffected merchant producers, mainly thermoplastic producers, unambiguously gain at the expense of affected merchant producers and consumers of RPC products. Lastly, although not included in the market analysis, the Agency projects directly affected captive facilities to incur a loss in pre-tax earnings of \$18 million annually, which is assumed to be equal to the aggregate engineering estimate of compliance costs, reflecting the Agency's inability to predict higher prices for their end products and, thus, shift costs to their ultimate consumers.

Additional distributional impacts of the rule within the directly affected merchant producers are not apparent from the reported decline in their aggregate pre-tax earnings. The regulation creates both gainers and losers within the directly affected merchant segment. As shown in Table 4-6, a substantial subset of the merchant facilities are projected to experience profit increases under the recommended alternative (i.e., 93 facilities representing 31 percent of the sector total of 299 facilities). Their gain in operating profit is projected to be \$3.9 million annually. However, the majority of directly affected merchant facilities (i.e., 177 facilities, or 59 percent of the sector total) are projected to lose pre-tax earnings of \$4.7 million per year. The remaining 29 facilities are projected to cease operations and, thus, forego \$0.3 million in baseline pre-tax earnings. The merchant facilities with profit gains tend to have higher output rates (average of 4.2 million pounds per facility) and lower per-unit compliance costs (<\$0.01 per pound) than the negatively affected facilities. Facilities that experience profit losses or shutdown are generally lower-volume facilities (average of 0.8 million pounds per year) and have higher per-unit compliance costs (average ranging from \$0.04 to \$0.25 per pound).

Table 4-6. Distributional Impacts on Merchant Thermoset Producers Associated with Reinforced Plastic Composites NESHAP Regulatory Alternatives: 1997

| | MACT Floor | | | | Recommended Alternative | | | | Above-the-MACT-Floor | | | |
|--|-----------------|-----------------|---------|--------|-------------------------|-----------------|---------|--------|----------------------|-----------------|---------|--------|
| | More Profitable | Less Profitable | Closure | Total | More Profitable | Less Profitable | Closure | Total | More Profitable | Less Profitable | Closure | Total |
| Facilities Production | 94 | 176 | 29 | 299 | 93 | 177 | 29 | 299 | 47 | 162 | 90 | 299 |
| Total (10 ⁶ lbs/yr) | 393 | 160 | 3 | 556 | 387 | 166 | 3 | 556 | 325 | 217 | 14 | 556 |
| Average (lbs/facility) | 4.2 | 0.9 | 0.1 | 1.9 | 4.2 | 0.9 | 0.1 | 1.9 | 6.9 | 1.3 | 0.2 | 1.9 |
| Compliance Costs | | | | | | | | | | | | |
| Total (\$10 ⁶ /yr) | \$0.9 | \$6.1 | \$0.6 | \$7.7 | \$1.1 | \$6.4 | \$0.6 | \$8.1 | \$4.3 | \$23.6 | \$8.5 | \$36.4 |
| Average (\$/lb) | <\$0.01 | \$0.04 | \$0.25 | \$0.01 | <\$0.01 | \$0.04 | \$0.25 | \$0.01 | \$0.01 | \$0.11 | \$0.61 | \$0.07 |
| Change in Pre-tax earnings (\$10 ⁶ /yr) | \$4.1 | -\$4.3 | -\$0.3 | -\$0.6 | \$3.9 | -\$4.7 | -\$0.3 | -\$1.1 | \$10.2 | -\$15.7 | -\$2.9 | -\$8.4 |
| Change in Employment | 16 | -272 | -644 | -900 | 16 | -271 | -644 | -900 | 22 | -37 | -2,270 | -2,285 |

Notes: More profitable—includes facilities with higher pre-tax earnings with the regulatory alternatives.
Less profitable—includes facilities with lower pre-tax earnings with the regulatory alternatives.
Closure—includes facilities that would cease production with the regulatory alternatives.

As with the market-level results, there is little difference in the industry-level profitability and the distribution of profit changes between the recommended and less stringent MACT floor alternative. However, the same conclusion cannot be drawn when examining the above-the-MACT floor alternative. Eighty-four percent of the affected merchant producers become less profitable or close (profit losses of \$18.6 million), and estimates of captive producer profit losses increase to \$31.0 million. Fifteen percent of the affected merchant producers become more profitable (\$10.2 million), while suppliers of thermoplastic RPCs experience a large increase in profits (\$21.0 million) because they benefit from higher prices and increased output.

4.5.2.2 Product-Line and Facility-Level Impacts

In the face of higher production costs, some facilities may find that their most economic response is to prematurely close the facility (presumably every current production facility will eventually close as new technologies replace old and current methods become economically unviable). Such a choice is optimal with regulation conditions when the facilities' projected revenues fall short of their variable costs (production and compliance). Under the recommended alternative, 29 merchant facilities are projected to close, or 10 percent of the total directly affected merchant facilities. As shown in Table 4-6, facilities expected to close have extremely low baseline output rates (average of 0.1 million pounds per facility) and significantly higher per-unit compliance costs (\$0.25 per pound).

A less severe response is available to producers with multiple production lines: close lines that are expected to be unprofitable with the regulation. This analysis projects that 73 product lines at directly affected merchant facilities (15 percent of the total) are expected to close with the recommended alternative. The product lines most affected by the regulation are the manual and mechanical resin applications because these processes typically have higher compliance costs. Ninety-seven percent of the product line closures employ these processes.

The number of projected closures does not decrease under the less stringent MACT floor alternative. However, the projected closures increase significantly under the above-the-floor alternative. The number of facility closures triples to 90 (30 percent of the total), and the number of product line closures more than doubles to 163 (35 percent of the total).

These impact estimates should be considered upper-bound estimates because the facilities may not cease operations for various reasons. For example, facility operators may

believe that market demand conditions may change and allow the facility to become profitable in the future. In addition, the terms of contractual agreements for independent suppliers may require them to continue operations or may allow the supplier to pass on a greater portion of these additional costs than the market model projects.

4.5.2.3 Changes in Employment

In response to the decreased levels of output, aggregate employment in the merchant segment of the RPC industry is projected to decrease by 1.2 percent, or 809 employees, under the recommended alternative. This is the net result of employment losses for merchant thermoset producers (900 employees) and employment gains for unaffected (i.e., thermoplastic) producers (91 employees). Although captive producers incur compliance costs that will likely influence levels of employment, EPA did not attempt to project changes in employment for these facilities. Employment changes for the MACT floor alternative are identical (809 employees, or 1.2 percent) but more than double under the more stringent above-the-floor alternative (2,021 employees, or 2.9 percent).

4.6 Social Costs

The value of a regulatory action is traditionally measured by the change in economic welfare that it generates. Welfare impacts, or the social costs required to achieve the environmental improvements, resulting from this regulatory action will extend to the many consumers and producers of RPC products. Consumers will experience welfare impacts due to changes in market prices and consumption levels associated with imposition of the regulation. Producers will experience welfare impacts resulting from changes in their revenues associated with imposition of the regulation and the corresponding changes in production and market prices. However, it is important to emphasize that this measure does not include benefits that occur outside the market, that is, the value of reduced levels of air pollution with the regulation.

For this analysis, based on applied welfare economics principles, social costs as described above are measured as the sum of the expected changes in consumer and producer surplus (see Appendix B for a more complete discussion). Consumers experience reductions in consumer surplus because of increased market prices. Producers may experience either increases or decreases in producer surplus (i.e., profits) as a result of increased market prices and changes in production and compliance costs.

The national estimate of compliance costs is often used as an approximation of the social cost of the rule. Under the recommended alternative, the engineering analysis estimated annual costs of \$26.1 million. However, this estimate does not account for behavioral responses by producers or consumers to imposition of the regulation (e.g., shifting costs to other economic agents, shutting down product lines or facilities). Accounting for these responses results in a social cost estimate that differs from the engineering estimate as well as provides insights on how the regulatory burden is distributed across society (i.e., the many consumers and producers of RPC products). Therefore, based on the market analysis described above, the annual social costs of the recommended alternative are projected to be \$25.7 million. The slight difference between the two estimates is due to the reductions in RPC product output triggered by the rule.

For the national compliance cost estimate, the regulatory burden falls solely on affected facilities, whose owners experience a profit loss exactly equal to that amount. In this case, this is entirely a loss in producer surplus with no change (by assumption) in consumer surplus. However, the Agency's economic analysis demonstrates that these costs are allocated between consumers and producers based on the market positions of each.² Table 4-7 provides the social costs and their distribution across stakeholders for each regulatory alternative.

On the producer side, suppliers using regulated thermosetting resins incur compliance costs. Some of these costs are passed on to consumers through higher prices, with the remainder absorbed by the owners of the directly affected facilities. As shown, for the recommended alternative, the loss in producer surplus for these suppliers is \$19.1 million annually. However, producers using unregulated resins will also sell their RPC products at the same (higher) price because these products are assumed to be perfect substitutes for those produced using thermosets. Because they do not incur any compliance costs, the owners of these facilities will have profit increases of \$7.1 million annually. On net, RPC suppliers'

² In the long run, we would expect that all costs of the rule would be passed on to consumers in the form of higher product prices. This is because investors will not invest in new plants and equipment unless they expect to cover all their costs of production and earn a return on investment appropriate for the risk they are incurring. However, currently fixed assets specific to RPC product production are the result of past investment decisions that cannot be reversed today. Thus, over the next 10 to 20 years owners of these facilities will have to decide how best to use these resources. The economic model developed for this analysis has attempted to capture these decisions.

Table 4-7. Social Costs with Reinforced Plastic Composites NESHAP Regulatory Alternatives: 1997

| Social Cost Component | MACT Floor | Recommended Alternative | Above-the-MACT-Floor |
|--|------------|-------------------------|----------------------|
| Consumer Surplus Loss/Gain (\$10 ⁶ /yr) | -\$13.75 | -\$13.73 | -\$43.29 |
| Aircraft/Aerospace | -\$0.01 | -\$0.01 | -\$0.01 |
| Appliances/Business Equipment | -\$0.10 | -\$0.10 | -\$0.54 |
| General Construction | -\$1.26 | -\$1.26 | -\$4.61 |
| Plumbing Fixtures | -\$1.79 | -\$1.78 | -\$8.57 |
| Panels | -\$0.21 | -\$0.21 | -\$0.36 |
| Consumer Products | -\$1.03 | -\$1.03 | -\$3.02 |
| Corrosion-Resistant | -\$5.24 | -\$5.24 | -\$13.83 |
| Electrical/Electric | -\$0.21 | -\$0.21 | -\$0.59 |
| Land Transportation | -\$3.37 | -\$3.37 | -\$9.70 |
| Miscellaneous | -\$0.52 | -\$0.52 | -\$2.08 |
| Producer Surplus Loss/Gain (\$10 ⁶ /yr) | -\$2.11 | -\$11.95 | -\$18.73 |
| Thermosets (Directly Affected) | -\$9.23 | -\$19.08 | -\$39.34 |
| Merchant | -\$0.60 | -\$1.05 | -\$8.37 |
| Captive | -\$8.63 | -\$18.03 | -\$30.96 |
| Thermosets/Thermoplastics (Indirectly Affected) | \$7.12 | \$7.12 | \$20.61 |
| Social Costs of Regulation (\$10 ⁶ /yr) | -\$15.85 | -\$25.69 | -\$62.02 |

profits are expected to decrease by \$12 million because the losses of the directly affected sector outweigh the gains of the indirectly affected sector.

It is important to point out that by modeling these products as perfect substitutes, the Agency has unambiguously overstated both the profit loss by affected producers and profit gain by unaffected producers. If modeled separately with interaction measured through a cross-price demand elasticity (inelastic or moderately elastic), then the projected price increase would be higher for affected products and lower for unaffected products. In addition, these differentiated price changes would cause the consumer surplus changes described below to understate impacts on the consumers of directly affected RPC products and overstate impacts on consumers of unaffected products.

On the consumer side, welfare losses are critically dependant on consumers' ability to find substitutes for RPC products and on the terms they can purchase those products. Because RPC products made from thermoplastics are assumed here to be perfect substitutes for those produced by the regulated entities, consumers are indifferent in their source of supply for these products, and there is a single market price for each RPC product regardless of the input used in its production. Thus, just as producers of the indirectly affected sector can be expected to gain with the rule, their customers will experience losses in economic welfare due to the higher prices for RPC products. Under the recommended alternative, the loss in consumer welfare is \$13.7 million annually. Consumers of corrosion-resistant and land transportation are expected to experience the largest consumer surplus losses (see Table 4-7).

An important model parameter affecting the estimated consumer surplus losses is the elasticity of demand for the RPC products. As discussed above, the Agency believes that a value of -0.5 is warranted based on a review of the impacted factor demand elasticities. However, as shown in Figure 4-4, if the value is larger (smaller), the consumer surplus losses estimate would be more (less).

Thus, in returning to the social costs of the recommended alternative, it is simply

| | |
|-------------------------------|------------------------|
| Directly affected producers | -\$19.1 million |
| Indirectly affected producers | +\$7.1 million |
| Consumers | <u>-\$13.7 million</u> |
| Social cost | \$25.7 million |

In comparison, the social costs of the MACT floor alternative are about \$15.9 million, those of the above MACT floor alternative, \$62.0 million.

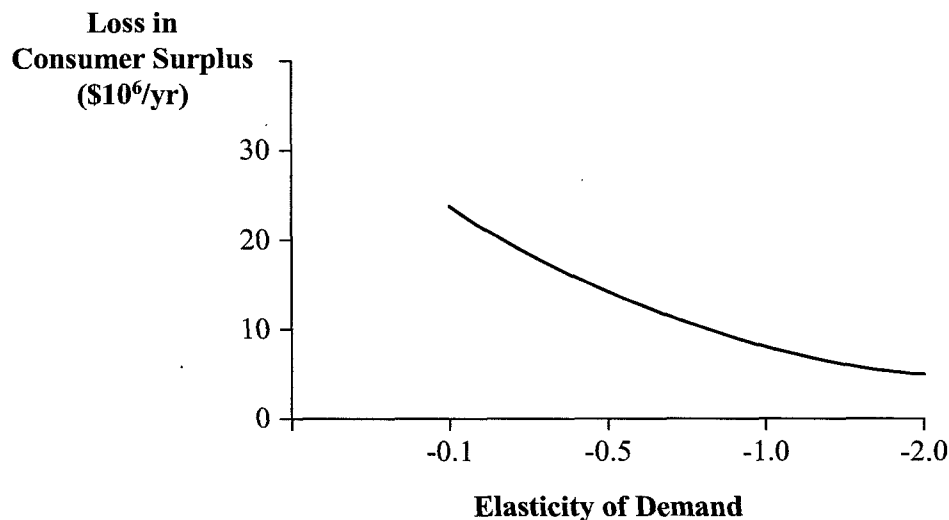


Figure 4-4. Sensitivity of Changes in Consumer Surplus to the Elasticity of Demand (Elasticity of Supply = 1.0)

4.7 Sensitivity Analysis for Profit Rate

The baseline profitability of producers is a key parameter in the Agency's economic modeling. However, obtaining profit data for firms that produce reinforced plastic composites is difficult because these firms are most often privately owned and, thus, do not publish the requisite financial information. In lieu of firm-specific profit rates, the Agency applied an industry average profit rate of 4.4 percent for each facility. As applied for this analysis, this rate reflects the maximum profit rate for an individual facility, i.e., a threshold level of profitability. Those facilities whose total revenue minus production costs resulted in a return of less than 4.4 percent of revenues used the lower rate for determination of economic viability or regulation induced closure.

In 1997, the baseline year of the economic analysis, the industry average profit rate was 6.5 percent as reported for SIC 30 by the Census Bureau's Quarterly Financial Report (QFR). This profit rate reflects income before income taxes as a share of sales for firms with less than \$25 million in assets. However, this analysis must address the impacts on many firms that have less than \$25 million in assets which often have lower profit rates. The pre-tax earnings for plastic companies with less than \$5 million in sales was on average two-

thirds of that for plastic companies with between \$10 and \$25 million in sales (SPI, 1998). Thus, to better reflect the profit rates for smaller companies for our analysis, the Agency used this two-thirds ratio to adjust the QFR reported industry average profit rates for firms less than \$25 million in assets, i.e.,

| <u>Year</u> | <u>Industry Average</u> | <u>Adjusted Average</u> |
|-------------|-------------------------|-------------------------|
| 1999 | 4.7% | 3.0% |
| 1998 | 6.0% | 4.0% |
| 1997 | 6.5% | 4.4% |
| 1996 | 5.5% | 3.7% |
| 1995 | 5.2% | 3.5% |

As shown, the profitability measures range over this time period from 3 to 6.5 percent of sales. Therefore, as a sensitivity, the Agency evaluated the economic impacts for the recommended alternative for this broader range of baseline profitability scenarios. As shown in Table 4-8, the market impacts are slightly greater (lower) under the lower (higher) profit rate scenario with very slight differences in social costs. However, the estimated number of product-line and facility closures is affected by the change in profit rate scenarios with more (less) product-lines and facilities closing under the lower (higher) profit rate scenario. Interestingly, the closing of less profitable product-lines and facilities under the 3 percent scenario results in an aggregate profit gain by merchant facilities that continue to operate with regulation. This aggregate gain results from their increased revenues associated with their gain in market share and the higher prices with regulation.

4.8 New Source Analysis

New suppliers of RPCs have an investment decision: whether to commit to a new facility of a given scale. They have no fixed factors and thus may select any technically feasible facility configuration. Of course, they may also elect not to make an investment in this industry. Economic theory suggests investors are expected to invest in a project when the discounted value of the expected stream of profits over the lifetime of the investment exceeds the costs of the investment, or alternatively when the internal rate of return (IRR) is greater than the opportunity cost of capital. Commodity prices and production costs are central to this decision.

The competitive model of price formation is provided in Figure 4-5. In the figure, the willingness of existing suppliers to produce alternative rates of RPCs is represented by S_e and the demand for RPCs is shown as D_0 . The equilibrium market price, P_0 , is determined by the intersection of these curves. If this price exceeds the annualized capital costs discounted at

**Table 4-8. Summary of Economic Impacts Under Range of Industry Profit Rates:
Recommended Alternative**

| Economic Impact Measure | Industry Profit Rate | | |
|--|----------------------|---------|---------|
| | 3.0% | 4.4% | 6.5% |
| All Composites | | | |
| Market price (percent change) | 0.5% | 0.3% | 0.2% |
| Market output (percent change) | -0.3% | -0.2% | -0.1% |
| Directly affected producers | -1.2% | -0.8% | -0.6% |
| Indirectly affected producers | 0.5% | 0.3% | 0.3% |
| Change in Pre-tax earnings (\$10 ⁶ /yr) | | | |
| Merchant facilities | \$2.6 | -\$1.1 | -\$2.1 |
| Captive facilities | -\$18.0 | -\$18.0 | -\$18.0 |
| Closures | | | |
| Product lines | 97 | 73 | 33 |
| Facilities | 45 | 29 | 17 |
| Social costs (\$10 ⁶ /yr) | \$25.3 | \$25.7 | \$25.8 |

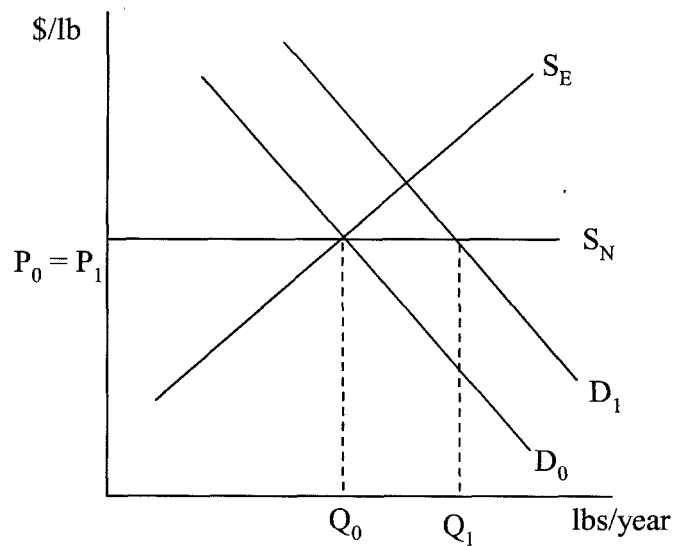


Figure 4-5. Baseline Equilibrium without Regulation

the opportunity cost of capital for an investment in this risk class divided by the profit-maximizing output rate plus the unit cost of other inputs, the producer commits to a new facility; otherwise no investment occurs. Figure 4-5 shows a constant cost industry where market price is exactly equal to the unit cost of new facilities, S_N .

In a growing industry, the demand for the commodity is shifting outward (e.g., to D_1), placing upward pressure on prices and providing the incentive for investors to add new productive capacity.³ As new capacity enters the market, the new equilibrium price is P_1 , which is exactly equal to the unit cost of supply from new facilities. In this example, it is the same value as the old price, P_0 . The new equilibrium quantity, Q_1 , includes the additional output supplied by new sources: $(Q_1 - Q_0)$.

The NESHAP will increase existing suppliers' costs of producing RPCs if they use thermosetting resins by shifting existing supply, S_e , up. It will also increase the costs of supply from new facilities using these resins. These increases in costs will place upward pressure on prices. As shown in Figure 4-6, with demand curve, D_1 , prices would be expected to increase with shifts in supply until the price of RPCs, P_1' , is equal to the unit cost of supply from new facilities including the cost of the NESHAP. However, as shown in Figure 4-7, no new capacity expansion will take place in the future time period (1) if the per-unit compliance costs at new facilities exceeded, P_1' . Thus, the simple analytics presented suggest that the rule will likely cause investors to delay construction of new facilities *until the price increases just enough* to cover all the costs of production.

Given the uncertainty about new facility unit costs (production and compliance) and future market conditions, the Agency is limited to general assessments of the rule's impact on the rate of new facility construction. To inform these assessments, the Agency performed the following analysis:

- *computed a test ratio for each of the ten affected RPC markets.* The numerator of this ratio is the engineering estimate of the unit costs of compliance for new sources (\$0.02 per pound for a new facility subject to the MACT floor standard and \$0.06 for a facility subject to the above-the-MACT floor standard). The denominator for this ratio is the unit cost of a new supplier, which is assumed to be equal to the baseline market price. As shown in Table 4-9, this ratio is small under the MACT floor standard (less than 1 percent) and increases to approximately 1.7 percent under the above-the-floor standard.

³For simplicity, impacts are considered for one future time period.

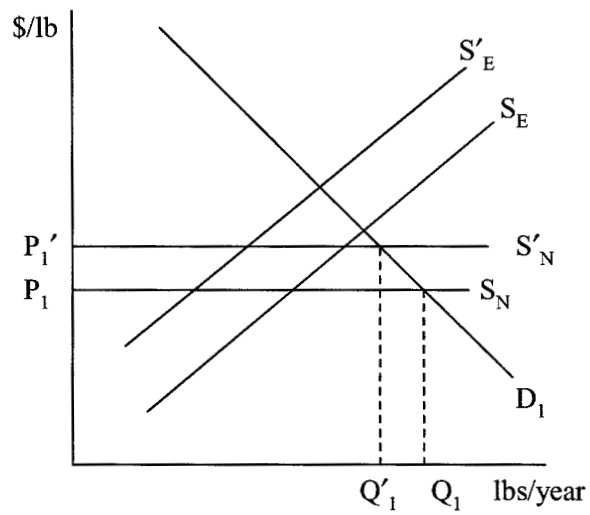


Figure 4-6. With-Regulation Equilibrium Case 1: New Sources Added

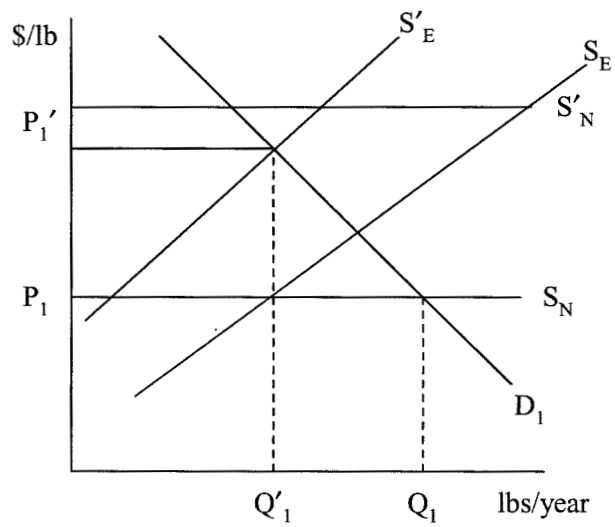


Figure 4-7. With-Regulation Equilibrium Case 2: No New Sources Added

Table 4-9. New Source Analysis of Unit Production and Compliance Costs (\$1997)

| Market | New Source Unit Costs (\$/lb) ^a | MACT Floor | | Above-the-MACT Floor | |
|-------------------------------|---|--|-------------------|--|-------------------|
| | | New Source Unit Compliance Costs (\$/lb) | Cost Share (%) | New Source Unit Compliance Costs (\$/lb) | Cost Share (%) |
| Aircraft/aerospace | \$38.35 | \$0.02 | 0.04% | \$0.06 | 0.15% |
| Appliances/business equipment | \$2.37 | \$0.02 | 0.68% | \$0.06 | 2.46% |
| General construction | \$3.46 | \$0.02 | 0.47% | \$0.06 | 1.68% |
| Plumbing fixtures | \$3.48 | \$0.02 | 0.47% | \$0.06 | 1.67% |
| Panels | \$3.24 | \$0.02 | 0.50% | \$0.06 | 1.80% |
| Consumer products | \$3.41 | \$0.02 | 0.48% | \$0.06 | 1.71% |
| Corrosion-resistant | \$3.77 | \$0.02 | 0.43% | \$0.06 | 1.54% |
| Electrical/electric | \$3.29 | \$0.02 | 0.49% | \$0.06 | 1.77% |
| Land transportation | \$3.44 | \$0.02 | 0.47% | \$0.06 | 1.69% |
| Miscellaneous | \$3.41 | \$0.02 | 0.48% | \$0.06 | 1.71% |
| Total | \$3.48 | \$0.02 | 0.47% | \$0.06 | 1.67% |

^a Equal to the baseline market price by assumption.

- *projected percentage changes in facility construction with regulation for a future time period (2005).* Using the conceptual approach presented in Figures 4-5 and 4-6, the Agency estimated the change in facility construction for the period 2000 to 2005 as follows:

$$\Delta \text{Facilities} = \frac{\Delta Q_{2005}}{Z} = \eta_d \cdot Q_{2005} \cdot \frac{\Delta P}{P} \quad (4.1)$$

where

η_d = Elasticity of demand (-0.5)

Z = Average size of a new facility (2.4 million lbs/yr)

Q_{2005} = For 2000, the Composite Fabricators Association (CFA, 2000) estimated an RPC composite demand of 3.5 billion pounds.⁴ For the period 2000 to 2005, the engineering analysis independently projected resin growth of 123.9 million pounds. Using a composite-to-resin weight ratio of 1.6, the Agency estimated a RPC composite growth of 198.3 million pounds. Thus, the quantity for the baseline year of 2005 was estimated to be approximately 3.7 billion pounds.

$\frac{\Delta P}{P}$ = Calculated using the ratio of average new source per-unit control costs to baseline price for each alternative (0.47 percent for the MACT floor alternative and 1.67 percent for the above-the-floor alternative)

Using this approach, the Agency estimated a 5 percent reduction in facility construction under the MACT floor alternative and a 15 percent reduction under the above-the-floor alternative over the 2000 to 2005 time period (see Table 4-10).

These results suggest minimal impacts on facility construction under the MACT floor alternative. However, facility construction impacts would increase significantly if all new producers were subject to the above-the-floor standard. As described earlier in this section, the appropriate control standard under the recommended alternative is determined by the size of the new source. Thus, the control costs influence the decision to enter the market *and*, perhaps, the producer's selection of plant size. Since the unit control costs are smaller for facilities with low output rates, it is possible that the average size of new facilities may tend to be smaller to be subject to the MACT floor rather than above-the-MACT floor standards.

⁴Excludes marine uses.

**Table 4-10. Changes in Facility Construction Under the Proposed NESHAP:
2000–2005**

| | Number of Facilities Without Regulation | MACT Floor Change | | Above-the-MACT Floor Change | |
|-------------|--|-------------------|----------|--------------------------------|----------|
| | | Absolute | Relative | Absolute | Relative |
| New sources | 84 | –5 | –4.8% | –13 | –15.5% |

SECTION 5

INITIAL REGULATORY FLEXIBILITY ANALYSIS

Section 112 of the CAA requires the Agency to list categories and subcategories of major sources and, in some cases, area sources of HAP and to then establish national emission standards. Reinforced Plastic Composites (RPC) production facilities that were major sources were included on the initial list of source categories. Major sources of HAP are those that have the potential to emit 10 tons per year (tpy) or more of any one HAP or 25 tpy or more of any combination of HAP. The HAP emitted by sources in this source category include styrene, methyl methacrylate, and methylene chloride. These HAP have been demonstrated to cause adverse health effects. Therefore, the proposed rule protects air quality and promotes public health by reducing the current emission levels of these HAP.

The objective of this proposed rule is to apply standards based on maximum achievable control technology to all major sources in this source category. The criteria used to establish MACT are contained in section 112 (d) of the CAA.

This regulatory action will potentially affect the economic welfare of owners of RPC facilities. These individuals may be owners/operators who directly conduct the business of the firm (i.e., “mom and pop shops” or partnerships) or, more commonly, investors or stockholders who employ others to conduct the business of the firm on their behalf (i.e., privately held or publicly traded corporations). The individuals or agents who manage these facilities have the capacity to conduct business transactions and make business decisions that affect the facility. The legal and financial responsibility for compliance with a regulatory action ultimately rests with these agents; however, the owners must bear the financial consequences of the decisions. Environmental regulations like this rule potentially affect all businesses, large and small, but small businesses may have special problems in complying with such regulations.

The Regulatory Flexibility Act (RFA) of 1980 requires that special consideration be given to small entities affected by federal regulation. The RFA was amended in 1996 by the Small Business Regulatory Enforcement Fairness Act (SBREFA) to strengthen the RFA’s analytical and procedural requirements. Under SBREFA, the Agency implements the RFA as

written with a regulatory flexibility analysis required only for rules that will have a *significant* impact on a *substantial* number of small entities.

In accordance with Section 603 of the RFA, the Agency has prepared this initial regulatory flexibility analysis (IRFA) that examines the impact of the proposed rule on small entities within this source category along with regulatory alternatives that could reduce that impact. As detailed in this section, EPA identified the businesses that this proposed rule will affect and conducted an economic analysis to determine whether this rule is likely to impose a significant impact on a substantial number of the small businesses within this industry. The analysis employed here is a “sales test,” which computes the annualized compliance costs as a share of sales for each company. In addition, it provides information about the impacts on small businesses after accounting for producer responses to the regulation and the resulting changes in market prices and output for RPC products.

As required by Section 609(b) of the RFA, as amended by SBREFA, the Agency convened a Small Business Advocacy Review (SBAR) panel to obtain advice and recommendations of representatives of the small entities that potentially would be subject to the rule’s requirements. Prior to convening the SBAR panel, EPA conducted a “sales test” for small businesses based on a earlier provisions considered for inclusion in the proposed rule. The results of that analysis indicated much more significant impacts on small entities than the rule as it is currently being proposed. The reduction in impacts is a direct result of the SBAR panel’s recommendations incorporated in this proposed rule.

5.1 Identifying Small Businesses

As described in Section 2 of this report, the Agency identified a substantial number of small businesses potentially affected by the proposed NESHAP. Based on SBA definitions, 278 companies are classified as small, or 78 percent of the total. These companies own 302 facilities, or 70 percent, of all RPC facilities.

5.2 Screening-Level Analysis

For the purposes of assessing the potential impact of this rule on these small businesses, the Agency considered the recommended alternative, the MACT floor, and an above-the-MACT-floor alternative and calculated the share of annual compliance cost relative to baseline sales for each company. When a company owns more than one affected facility, the costs for each facility it owns are summed to develop the numerator of the test ratio. For this screening-level analysis, annual compliance costs were defined as the

engineering control costs imposed on these companies; thus, they do not reflect the changes in production expected to occur in response to imposing these costs and the resulting market adjustments. The results of this initial screening analysis are discussed below.

5.2.1 Recommended Alternative

As shown in Table 5-1, the aggregate compliance costs of the recommended alternative for small businesses total \$8.1 million, or 31 percent of the total industry costs of \$26.1 million. The average total annual compliance cost was projected at roughly \$30,000 per small company as compared to the average of 230,000 per large company. The annual compliance costs for small businesses range from 0.01 to 7.50 percent of sales. The average (median) compliance cost-to-sales ratio (CSR) is 0.66 (0.40) percent for the identified small businesses with sales data and 0.07 (<0.01) percent for the large businesses with sales data. As shown, 46 small companies (17 percent) are affected at the 1 percent to 3 percent level and 7 (3 percent) companies are affected at or above the 3 percent level. Thus, a total of 53 small companies, or 19 percent, are expected to incur costs greater than 1 percent of their sales. Furthermore, the distribution of the CSRs, as shown in Figures 5-1(a) and (b), demonstrate that small companies are disproportionately affected relative to large companies.

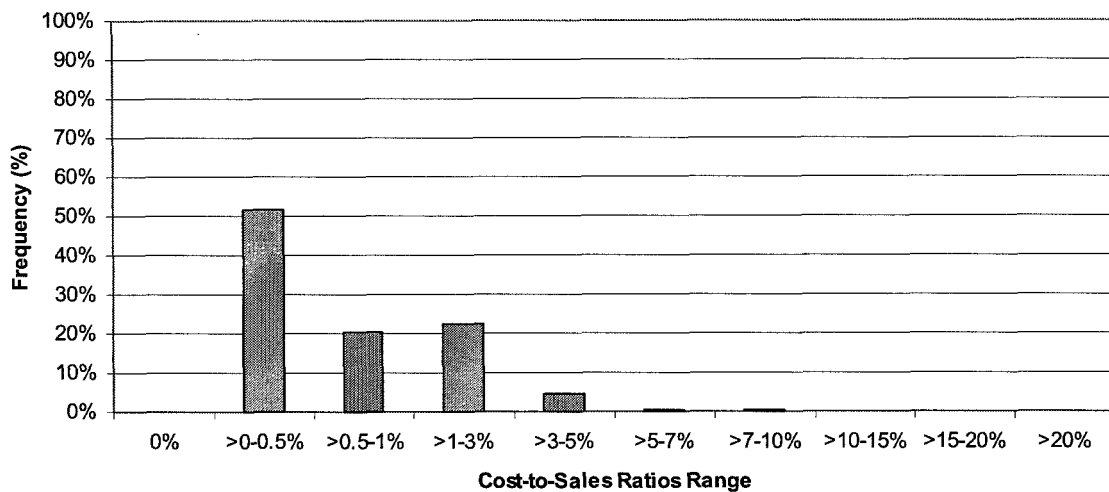
Similar analysis of earlier provisions under consideration for inclusion in this rule indicated greater impacts on small businesses than this proposed rule. Almost 42 percent of the total industry compliance costs were expected to be incurred by small businesses based on requirements of the draft versions of this rule. The average total annual compliance cost was projected at roughly \$50,000 per small company, which represented close to 1 percent of sales. The Agency estimated that 22 percent of small businesses (or 60 firms) would experience an impact greater than 1 percent of sales, and 7 percent of small businesses (or 19 firms) would experience impacts greater than 3 percent of sales. The reduction in small business costs between earlier versions of this rule and the proposed rule are attributable to EPA's outreach and accommodation for small firms, which includes the conduct of the Small Business Advocacy Panel.

Table 5-1. Summary Statistics for SBREFA Screening Analysis: Recommended Alternative

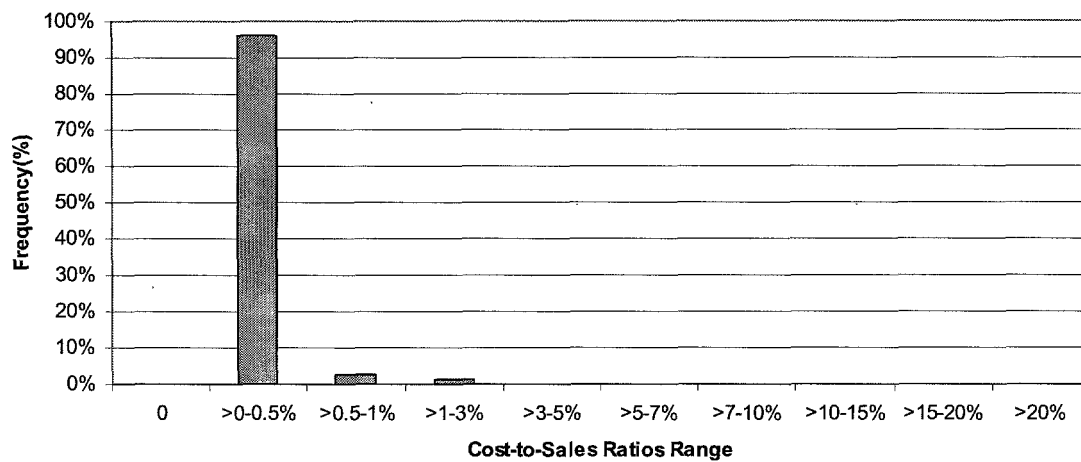
| | Small | | Large | | All Companies | |
|---|--------|-------|--------|--------|---------------|--------|
| Total Number of Companies | 278 | | 78 | | 356 | |
| Total Annual Compliance Costs (TACC) (\$10 ⁶) | \$8.1 | | \$18.0 | | \$26.1 | |
| Average (TACC) per company (\$10 ⁶) | \$0.03 | | \$0.23 | | \$0.07 | |
| Companies with Sales Data ^a | Number | Share | Number | Share | Number | Share |
| | 275 | 100% | 78 | 100% | 353 | 100% |
| Compliance costs are <1% of sales | 222 | 81% | 77 | 99% | 299 | 85% |
| Compliance costs are ≥ 1 to 3% of sales | 46 | 17% | 0 | 0% | 46 | 13% |
| Compliance costs are ≥ 3% of sales | 7 | 3% | 1 | 1% | 8 | 2% |
| Compliance Cost-to-Sales Ratios | | | | | | |
| Average | | 0.66% | | 0.07% | | 0.53% |
| Median | | 0.40% | | <0.01% | | 0.21% |
| Maximum | | 7.50% | | 3.53% | | 7.50% |
| Minimum | | 0.01% | | <0.01% | | <0.01% |

^a Annual sales data were unavailable for three ultimate parent companies. CSRs cannot be computed for these companies.

Note: Assumes no market responses (i.e., price and output adjustments) by regulated entities.



**Figure 5-1(a). Distribution of Cost-to-Sales Ratios for Small Companies:
Recommended Alternative**



**Figure 5-1(b). Distribution of Cost-to-Sales Ratios for Large Companies:
Recommended Alternative**

5.2.2 *MACT Floor Alternative*

As shown in Table 5-2, the aggregate compliance costs of the MACT floor alternative for small businesses total \$7.7 million, which is nearly half (47 percent) of the total industry costs of \$16.3 million. The annual compliance costs for small businesses range from 0.01 to 7.50 percent of sales. The average (median) compliance CSR is 0.66 (0.40) percent for the identified small businesses with sales data and 0.03 (<0.01) percent for the large businesses with sales data. As shown, 45 small companies (16 percent) are affected at the 1 percent to 3 percent level and 7 companies (3 percent) are affected at or above the 3 percent level. A total of 52 small companies, or 19 percent, are affected above the 1 percent test ratio, representing a decrease of only one company as compared to the recommended alternative. As shown in Figures 5-2(a) and (b), the relative impacts between small and large companies are similar to the recommended alternative.

5.2.3 *Above-the-MACT Floor Alternative*

As shown in Table 5-3, the aggregate compliance costs of the above-the-MACT floor alternative for small businesses total \$40.2 million, or 60 percent of the total industry costs of \$67.4 million. The annual compliance costs for small businesses range from 0.01 to 25.89 percent of sales. The average (median) compliance CSR is 3.97 (2.65) percent for the identified small businesses with sales data and 0.15 (0.03) percent for the large businesses with sales data. As shown, 88 small companies (32 percent) are affected at the 1 percent to 3 percent level and 126 companies (46 percent) are affected at or above the 3 percent level. Thus, a total of 214 small companies incur costs greater than 1 percent of their sales, which is four times the number affected under the recommended alternative. Figures 5-3(a) and (b) show that the disproportionate relative impact between small and large companies is even more pronounced than under the recommended alternative.

5.3 Economic Analysis

The Agency also analyzed the economic impacts on small businesses under with-regulation conditions expected to result from implementing the proposed NESHAP. Unlike the screening-level analysis described above, this approach examines small business impacts in light of the expected behavioral responses of producers and consumers to the regulation. As shown in Table 5-4, operating profits for facilities owned by small businesses are projected to decline by \$1 million under the recommended alternative. In addition, 73 product lines and 29 facilities are projected to close under the MACT floor alternative.

Table 5-2. Summary Statistics for SBREFA Screening Analysis: MACT Floor Alternative

| | Small | | Large | | All Companies | |
|---|--------|-------|--------|--------|---------------|--------|
| Total Number of Companies | 278 | | 78 | | 356 | |
| Total Annual Compliance Costs (TACC) (\$10 ⁶) | \$7.7 | | \$8.6 | | \$16.3 | |
| Average TAAC per company (\$10 ⁶) | \$0.03 | | \$0.11 | | \$0.05 | |
| | Number | Share | Number | Share | Number | Share |
| Companies with Sales Data ^a | 275 | 100% | 78 | 100% | 353 | 100% |
| Compliance costs are <1% of sales | 223 | 81% | 77 | 99% | 300 | 85% |
| Compliance costs are ≥ 1 to 3% of sales | 45 | 16% | 1 | 1% | 46 | 13% |
| Compliance costs are ≥ 3% of sales | 7 | 3% | 0 | 0% | 7 | 2% |
| Compliance Cost-to-Sales Ratios | | | | | | |
| Average | | 0.66% | | 0.03% | | 0.52% |
| Median | | 0.40% | | <0.01% | | 0.20% |
| Maximum | | 7.50% | | 1.25% | | 7.50% |
| Minimum | | 0.01% | | <0.01% | | <0.01% |

^a Annual sales data were unavailable for three ultimate parent companies. CSRs cannot be computed for these companies.

Note: Assumes no market responses (i.e., price and output adjustments) by regulated entities.

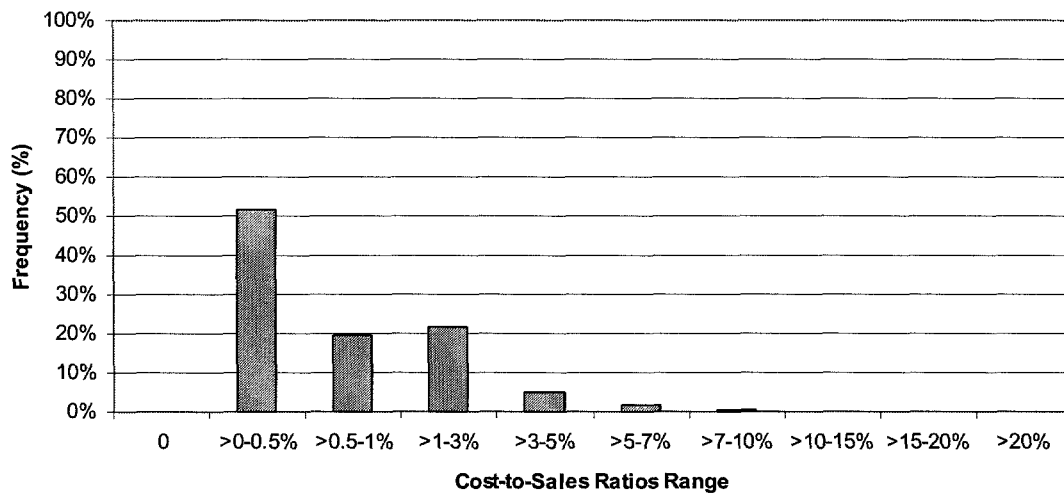


Figure 5-2(a). Distribution of Cost-to-Sales Ratios for Small Companies: MACT Floor Alternative

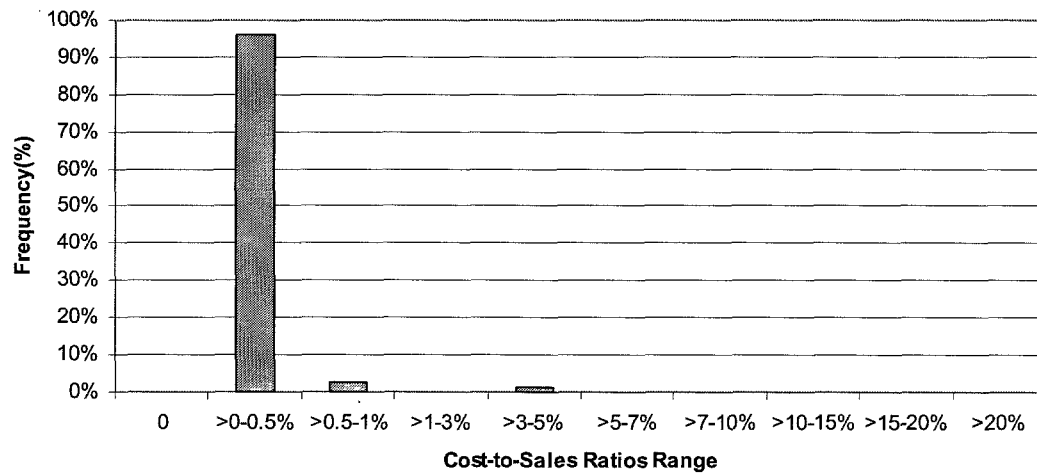


Figure 5-2(b). Distribution of Cost-to-Sales Ratios for Large Companies: MACT Floor Alternative

Table 5-3. Summary Statistics for SBREFA Screening Analysis: Above-the-MACT-Floor Alternative

| | Small | | Large | | All Companies | |
|---|--------|--------|--------|--------|---------------|--------|
| Total Number of Companies | 278 | | 78 | | 356 | |
| Total Annual Compliance Costs (TACC) (\$10 ⁶) | \$40.2 | | \$27.2 | | \$67.4 | |
| Average TACC per company (\$10 ⁶) | \$0.1 | | \$0.3 | | \$0.2 | |
| Companies with Sales Data ^a | Number | Share | Number | Share | Number | Share |
| | 275 | 100% | 78 | 100% | 353 | 100% |
| Compliance costs are <1% of sales | 61 | 22% | 76 | 97% | 137 | 39% |
| Compliance costs are ≥ 1 to 3% of sales | 88 | 32% | 1 | 1% | 89 | 25% |
| Compliance costs are ≥ 3% of sales | 126 | 46% | 1 | 1% | 127 | 36% |
| Compliance Cost-to-Sales Ratios | | | | | | |
| Average | | 3.97% | | 0.15% | | 3.13% |
| Median | | 2.65% | | 0.03% | | 1.75% |
| Maximum | | 25.89% | | 3.68% | | 25.89% |
| Minimum | | 0.01% | | <0.01% | | <0.01% |

^a Annual sales data were unavailable for three ultimate parent companies. CSRs cannot be computed for these companies.

Note: Assumes no market responses (i.e., price and output adjustments) by regulated entities.

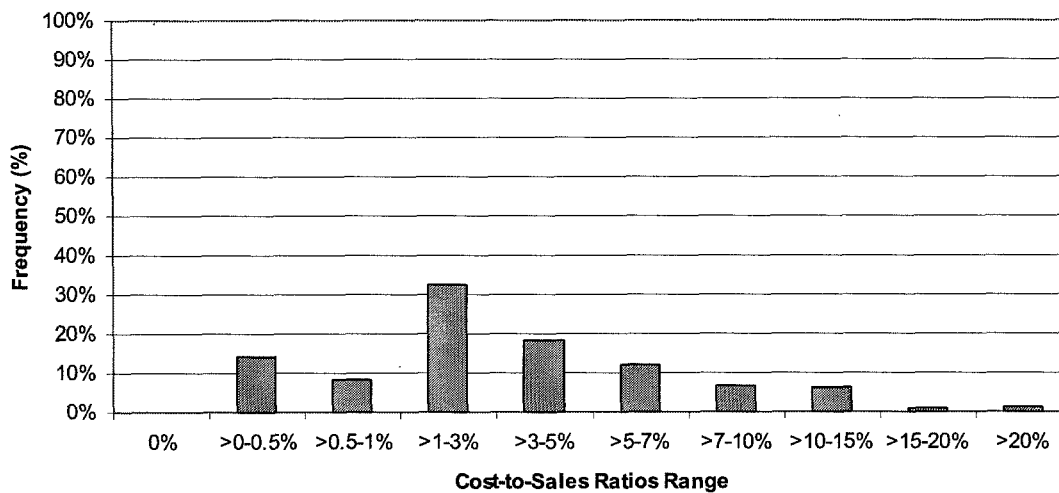


Figure 5-3(a). Distribution of Cost-to-Sales Ratios for Small Companies: Above-the-MACT-Floor Alternative

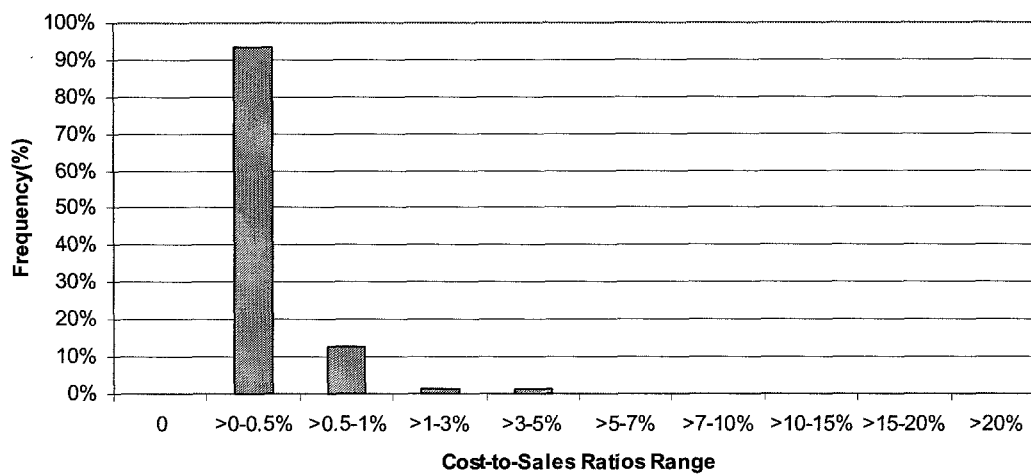


Figure 5-3(b). Distribution of Cost-to-Sales Ratios for Large Companies: Above-the-MACT-Floor Alternative

Table 5-4. Summary of Small Business Impacts of Reinforced Plastic Composites NESHAP

| | Baseline | MACT Floor Alternative | | Recommended Alternative | | Above-the-MACT-Floor Alternative | |
|--|------------------|------------------------|-----------------|-------------------------|-----------------|----------------------------------|-----------------|
| | | Absolute Change | Relative Change | Absolute Change | Relative Change | Absolute Change | Relative Change |
| Thermoset Producers (Directly Affected) | | | | | | | |
| Revenues (\$10 ⁶ /yr) | \$1,957 | -\$10 | -0.5% | -\$10 | -0.5% | -\$25 | -1.3% |
| Costs (\$10 ⁶ /yr) | \$804 | -\$9 | -1.2% | -\$9 | -1.1% | -\$15 | -1.9% |
| Compliance | — | \$7 | NA | \$7 | NA | \$28 | NA |
| Production | \$804 | -\$16 | -2.0% | -\$16 | -2.0% | -\$43 | -5.3% |
| Operating Profit (\$10 ⁶ /yr) | \$1,152 | -\$1 | -0.1% | -\$1 | -0.1% | -\$10 | -0.9% |
| Operating Entities | | | | | | | |
| Product Lines | 471 | -73 | 15.5% | -73 | 15.5% | -163 | 34.6% |
| Facilities | 299 ¹ | -29 | -9.7% | -29 | -9.7% | -90 | -30.1% |
| Employment | 18,223 | -916 | -5.0% | -916 | -5.0% | -2,310 | -12.7% |

Note: These estimates incorporate the expected market (i.e., price and output) adjustments of the regulated entities.

¹Three of the 302 facilities owned by small companies are excluded from the market analysis. They are treated as captive producers because they perform only intermediate operations such as compounding.

and the recommended alternative, while 163 product lines and 90 facilities are projected to close under the above-the-MACT-floor alternative.

5.4 Assessment

Although any facility closures are cause for concern, the number of facilities at risk for closure would be the same if this proposed rule required only the MACT floor level of control for all facilities. The MACT floor is the least stringent level allowed by statute. As a result of the SBAR panel, this rule contains a significant number of accommodations for small business. The results presented here confirm that the mitigating measures employed by the Agency have minimized the potential negative impacts of the proposed rule on small businesses while still satisfying the objectives of the CAA. The share of small companies affected at less than 1 percent exceeds 80 percent under both the recommended alternative and the MACT floor alternative. Furthermore, only 3 percent of small companies are projected to be affected at or above the 3 percent level for both the recommended and MACT floor alternative, while 46 percent of the small companies exceed this level under the above-the-MACT-floor alternative.

The economic analysis, which includes market responses to the regulation, provides the following results: 29 facilities (10 percent) owned by small businesses are projected to close under the recommended alternative and the MACT floor alternative. The number of facilities increases to 90 (30 percent) under the more stringent above-the-floor MACT alternative. These results are consistent with the industry's profitability and characterization of cost curves and engineering costs provided in earlier sections. This industry is characterized by average profit margins of 3 to 4 percent (Dun and Bradstreet, 1997). Under baseline conditions, small facilities have higher per-unit costs of production, reflecting economies of scale in the production of RPC. In addition, analysis of the engineering costs shows that these facilities also have higher per-unit compliance costs under with-regulation alternatives. Therefore, the economic impacts are likely to fall disproportionately on small facilities. However, as noted in Section 4, these entities may have contractual obligations that allow them to continue operation and potentially mitigate these impacts through terms that deal with contingencies.

The economic analysis also shows that producers using resins not directly affected by the regulation experience profit gains (e.g., \$8.7 million gain under the recommended alternative). This occurs because the prices of the commodities they produce will increase, but they do not incur compliance costs. Given the distribution of small and large entities

identified in the regulated segment, it is likely that a significant number of these producers may be small. Thus, a complete analysis of the small business impacts of the proposed rule would compute a net effect using the projected impacts on both directly (thermoset) *and* indirectly affected (thermoplastic) producers. Data limitations on the distribution of small businesses across the indirectly affected segment do not allow for quantitative estimates of net impacts. However, the qualitative analysis does suggest that small businesses using resins not directly affected by the rule will experience offsetting gains under with-regulation conditions.

We do not anticipate any impacts of the proposed NESHAP on small governments or small nonprofit organizations. We have no evidence that either small governments or nonprofit organizations own or operate sources that will be impacted by this proposed NESHAP.

5.5 Projected Reporting and Recordkeeping Requirements

The projected reporting and recordkeeping for these small businesses include initial notifications, startup notifications and compliance reports. We estimate that 302 existing facilities owned by small businesses will be impacted by these requirements, and 53 new facilities will be impacted in the first three years. The professional skills required to complete these reports include the ability to calculate emissions and resin use and read and follow report format guidance. All facilities impacted by this proposed rule should have personnel with the necessary skills because they would need these skills to comply with other regulatory requirements such as Toxic Release Inventory (TRI) reporting.

These recordkeeping and reporting requirements are specifically authorized by section 114 of the CAA (42 U.S.C. 7414) and are consistent with the General Provisions of 40 CFR part 63. All information submitted to us for which a claim of confidentiality is made will be safeguarded according to our policies in 40 CFR part 2.

Provisions to minimize the reporting and recordkeeping requirements on small business have been incorporated into this proposed rule. These provisions include allowing: the facility to substantiate resin and gel coat HAP contents with Material Safety Data Sheets rather than requiring testing of each resin and gel coat; use of resin purchase records to determine resin use; and exemption of facilities that can demonstrate that all their resin and gel coats comply with the required HAP content limits from the requirement to keep records

of resin use and calculate point value averages. These provisions have also been extended to all companies subject to the proposed NESHAP.

5.6 Other Federal Rules That May Impact Reinforced Plastic Composite Production Facilities

These facilities may also be subject to the NESHAP being developed for plastic parts and products. There should be no duplication of effort as a result of this proposed rule and the Plastic Parts and Products NESHAP being developed because these NESHAP will cover different operations. Facilities subject to this proposed rule are also subject to emissions estimate reporting under the TRI requirements. In this proposed rule, we could determine no ways to combine TRI and the reporting requirements of the proposed NESHAP because the objectives and statutory authorities of these requirements are different.

5.7 Alternatives to the Proposed Rule

We have incorporated significant alternatives into the proposed rule to minimize the impact on small business but still meet the objectives of the CAA.

As required by section 609(b) of the RFA, EPA conducted outreach to small entities and convened a SBAR panel to review advice and recommendations from representatives of the small entities that potentially would be subject to the proposed rule requirements. The panel convened on April 6, 2000 and was comprised of representatives from OMB, the SBA Office of Advocacy, the EPA Small Business Advocacy Chair, and the Emission Standards Division of the Office of Air Quality Planning and Standards of EPA. The panel solicited advice from 17 small entity representatives (SER) from a cross-section of the different industry sectors likely to be directly regulated by this action. On April 18, 2000, the panel distributed a package of descriptive and technical materials explaining the rule-in-progress to the SER. On May 2, 2000, the panel met with the SER to hear their comments on preliminary options for regulatory flexibility and related information. The panel also received written comments from the SER in response to both the outreach materials and the discussions at the meeting.

Consistent with RFA/SBREFA requirements, the panel evaluated the assembled materials and small-entity comments on issues related to the elements of the IRFA. A copy of the panel report is included in the docket for this proposed rule.

The panel considered numerous regulatory flexibility options in response to concerns raised by the SER. The major concerns included the affordability and technical feasibility of add-on controls, the resin and gel coat HAP contents required to meet some of the MACT floors, and the regulatory treatment of speciality products.

These are the major panel recommendations and EPA's response.

- Recommend setting higher thresholds than EPA had initially considered for requirements to use add-on controls.

Response: In the recommended regulatory alternative, EPA proposes to allow facilities owned by small firms to emit 250 tpy (as distinct from the 100 tpy limit for facilities owned by large firms) before installing add-on controls.

- Recommend setting the new source floor for small-owned sources at the level of the existing source floor.

Response: The recommended regulatory alternative includes this provision.

- Recommend establishing separate floors for speciality products.

Response: The recommended regulatory alternative includes this provision.

- Explore pollution-prevention alternatives to add-on controls.

Response: The EPA did explore this possibility with industry sources. Although we could not devise a workable pollution-prevention alternative to include in the recommended regulatory alternative, the Agency is requesting comment on how such a mechanism might be structured within the requirements of the CAA.

- Recommend allowing individual facilities to use the same resin in all resin application processes.

Response: The recommended regulatory alternative includes this provision.

- Reconsider the resin HAP content requirement for tooling resins.

Response: The recommended regulatory alternative includes a revised provision.

- Recommend separate floors for white and non-white gel coats.

Response: The recommended regulatory alternative includes this provision.

- Reconsider the Agency's estimates of the cost of add-on controls.

Response: Even though the recommended regulatory alternative eliminates the likelihood that existing small-owned facilities will be subject to add-on controls,

EPA has reconsidered its cost estimates in light of those offered by the industry. As discussed elsewhere in this preamble, EPA continues to believe our estimates are realistic.

- Recommend grouping high-strength applications with corrosion-resistant operations.

Response: The recommended regulatory alternative includes this provision.

Detailed information on all these recommendations is contained in the panel report in the docket for this proposed rule.

REFERENCES

- American Business Information (ABI). 1999. American Business Disc [computer file].
- Berglund, Lars. 1998. "Thermoplastic Resins." *Handbook of Composites*, S.T. Peters, ed. New York: Chapman and Hall.
- Composite Fabricators Association (CFA). 2000. "Industry Composites Demand for 1999–2000." <<http://www.cfa-hq.org>>. As obtained on July 29, 2000.
- Dialog Information Service. 1997. Standard and Poor's Corporations [computer file]. Palo Alto, CA: Dialog Information Service.
- Disclosure Incorporated. 1998. Worldscope [computer file]. Bethesda, MD: Disclosure Inc.
- Dun & Bradstreet. 1998. *Industry Norms & Key Business Ratios, Desk-Top Edition 1996-97*. Murray Hill, NJ: Dun & Bradstreet.
- Dun & Bradstreet. 1998. Dun's Market Identifiers [computer file]. New York, NY: Dialog Corporation.
- Dun & Bradstreet. 1999. *Million Dollar Directory: America's Leading Public and Private Companies*. Bethlehem, PA: Dun & Bradstreet Corporation.
- Gale Research, Inc. 1996. *Manufacturing USA*. Detroit, MI: Gale Research, Inc.
- Gale Research, Inc. 1998. *Ward's Business Directory of U.S. Private and Public Companies*. Detroit, MI: Gale Research, Inc.
- Information Access Corporation. 1998. Business & Company ProFile [computer file]. Foster City, CA: Information Access Corporation.
- LeFlam, Greg, and Melanie Proctor, PES Inc., memorandum to Madeleine Strum, U.S. Environmental Protection Agency. Industry Description Memorandum. October 17, 1995.

- Lindsay, Karen F. 1996. "State of the Industry: 1995-96." *Composites Design and Application* February.
- Modern Plastics*. "Resin Supply: What's in the Pipeline for '93?" January 1993.
- Modern Plastics*. "Resin Supply: Plotting a Course for Global Supply." January 1994.
- Murphy, John. 1994. *The Reinforced Plastics Handbook*. Oxford, UK: Elsevier Advanced Technology.
- Plastics News*. "Resin Pricing." Updated May 13, 1999. <<http://www.plasticsnews.com>>. As obtained on May 17, 1999.
- Predicasts Basebook*. November 1992. Foster City, CA: Information Access Corporation.
- Rauch Associates. 1991. *The Rauch Guide to the U.S. Plastics Industry*. Bridgewater, NJ: Rauch Associates, Inc.
- Schwartz, Mel. 1997. *Composite Materials: Processing, Fabrication, and Applications*. Upper Saddle River, NJ: Prentice Hall.
- Shearer, Brent. April 15, 1996. "Carbon Fibers Adjusting to Changes." *Chemical Marketing Reporter*.
- Society of the Plastics Industry, Inc. (SPI). 1994. *Facts and Figures of the U.S. Plastics Industry*. Washington, DC: SPI.
- Society of the Plastics Industry, Inc. (SPI). 1998. *Facts and Figures of the U.S. Plastics Industry*. Washington, DC: SPI.
- Society of the Plastics Industry (SPI) Composites Institute. 1992. *Introduction to Composites*. Second Edition. Washington, DC: Society of the Plastics Industry, Inc.
- Society of the Plastics Industry (SPI) Composites Institute. 1995. *Introduction to Composites*. Third Edition. Washington, DC: Society of the Plastics Industry, Inc.
- U.S. Bureau of Labor Statistics. 2000. Producer Price Index—Commodities: WPUSOP9200, Intermediate Materials less food and energy. 1990–2000. [online] <<http://www.bls.gov>>. Obtained January 20, 2000.
- U.S. Environmental Protection Agency (EPA). 1993. "Survey of Reinforced Plastics Industry." Washington, DC: U.S. Environmental Protection Agency.

- U.S. Environmental Protection Agency, Office of Enforcement and Compliance Assurance.
1995. *EPA Office of Compliance Sector Notebook Project: Profile of the Rubber and Plastics Industry*. Washington, DC: U.S. Environmental Protection Agency.
- U.S. Geological Survey. 1997. Minerals Yearbook: Clays. [online]
<<http://minerals.usgs.gov/minerals/pubs/commodity/myb>>. Obtained January 21, 2000.
- U.S. Geological Survey. 1997. Minerals Yearbook: Mica. [online]
<<http://minerals.usgs.gov/minerals/pubs/commodity/myb>>. Obtained January 21, 2000.
- U.S. Small Business Administration. 1996. Size Standards by SIC Industry.
<<http://www.sba.govgopher/Government-Contracting/Size/sizeall.txt>>.

Appendix A

Summary Data for Companies Owning Reinforced Plastic Composite Facilities

Table A-1. Summary Data for Companies Reinforced Plastic Composite Facilities

| Company Name | Facilities (#) | Sales (\$10⁶) | Employment | Small Business |
|--|---------------------------|-------------------------------------|-------------------|---------------------------|
| 20th Century Fiberglass Inc. | 1 | \$95.0 | 800 | No |
| A. R. E., Inc. | 2 | \$19.1 | 175 | Yes |
| A.F.P. Imaging | 1 | \$37.0 | 190 | Yes |
| A.O. Smith Corporation | 2 | \$1,645.7 | 13,000 | No |
| A-1 Fiberglass Inc. | 1 | \$5.1 | 50 | Yes |
| ABC Industries, Inc. | 3 | \$8.0 | 75 | Yes |
| Accent Marble Company Inc. | 1 | \$5.0 | 100 | Yes |
| Accra Industries Inc. | 1 | \$1.9 | 15 | Yes |
| Accurate Glass Inc. | 1 | \$3.0 | 35 | Yes |
| Acme Fiberglass Inc. | 1 | \$2.5 | 25 | Yes |
| Acme Reinforced Plastics Inc. | 1 | \$3.1 | 15 | Yes |
| Aero Transportation Corporation | 1 | \$5.8 | 76 | Yes |
| Aeroquip Inoac Company | 1 | \$65.0 | 560 | No |
| Agco Inc. | 1 | \$2,317.5 | 7,800 | No |
| Aker Plastics Company Inc. | 3 | \$36.0 | 400 | Yes |
| Alco Industries, Inc. | 1 | \$225.0 | 2,000 | No |
| Allen Group (The) | 1 | \$369.5 | 2,900 | No |
| Alliance Equipment Company Inc. | 1 | \$1.2 | 20 | Yes |
| Allied Moulded Prods. Inc. | 1 | \$17.7 | 240 | Yes |
| Altec Industries Inc. | 1 | \$250.0 | 1,800 | No |
| American Acrylic Corporation | 1 | \$3.5 | 36 | Yes |
| American Bluegrass Marble Company | 1 | \$2.9 | 63 | Yes |
| American Marble Company Inc. | 1 | \$0.9 | 19 | Yes |
| American Reinforced Plastics, Inc. | 1 | \$1.2 | 25 | Yes |
| American Slate & Marble of Hickory, Inc. | 1 | \$1.7 | 33 | Yes |
| American Standard Companies | 1 | \$5,805.0 | 44,000 | No |
| Americh Corporation | 2 | \$10.0 | 50 | Yes |
| Ameron International Corporation | 1 | \$533.5 | 2,761 | No |

(continued)

**Table A-1. Summary Data for Companies Reinforced Plastic Composite Facilities
(continued)**

| Company Name | Facilities (#) | Sales (\$10 ⁶) | Employment | Small Business |
|-----------------------------------|-------------------|-------------------------------|------------|-------------------|
| Amsted Industries | 1 | \$1,200.0 | 9,000 | No |
| An-Cor Indl. Plastics Inc. | 1 | \$7.5 | 150 | Yes |
| Appalachian Plastics Inc. | 1 | \$2.5 | 39 | Yes |
| Applied Composites, Corporation | 1 | \$10.0 | 200 | Yes |
| Aqua Bath | 1 | \$15.0 | 35 | Yes |
| Aqua-Air Manufacturers, Inc. | 1 | \$0.5 | 15 | Yes |
| Arjo Holding Company | 1 | \$16.0 | 150 | Yes |
| Armorcast Prods. Company | 1 | \$2.8 | 40 | Yes |
| Arrow Dynamics, Inc. | 1 | \$18.0 | 50 | Yes |
| Arrowhead Plastic Eng. Inc. | 1 | \$10.0 | 199 | Yes |
| Ashworth Bros. Inc. | 1 | \$64.3 | 600 | No |
| Athena Marble Inc. | 1 | \$2.0 | 26 | Yes |
| Attbar Plastics Inc. | 1 | \$8.0 | 150 | Yes |
| Austin Countertops Inc. | 1 | \$4.9 | 50 | Yes |
| Avnet | 1 | \$5,390.6 | NA | No |
| Bailey Corporation | 1 | \$79.0 | 1,245 | No |
| Baja Products Ltd. | 2 | \$4.5 | 42 | Yes |
| Baltek Corporation | 1 | \$48.6 | 1,131 | No |
| Bathcraft Inc. | 1 | \$14.0 | 170 | Yes |
| Beden-Baugh Products Inc. | 1 | \$1.4 | 20 | Yes |
| Bedford Reinforced Plastics | 1 | \$5.1 | 80 | Yes |
| Beetle Plastics Inc. | 1 | \$5.3 | 44 | Yes |
| Belding Tank Technology | 1 | \$7.1 | 50 | Yes |
| Bertch Cabinet Manufacturing Inc. | 1 | \$42.9 | 375 | Yes |
| Bittner Industries Inc. | 1 | \$2.5 | 15 | Yes |
| Blue Dolphin Fiberglass Pools | 1 | \$6.3 | 50 | Yes |
| Bolfing Brothers Marble Inc. | 1 | \$2.2 | 55 | Yes |

(continued)

**Table A-1. Summary Data for Companies Reinforced Plastic Composite Facilities
(continued)**

| Company Name | Facilities (#) | Sales (\$10 ⁶) | Employment | Small Business |
|--|-------------------|-------------------------------|------------|-------------------|
| Bowie Mfg. Inc. | 1 | \$3.9 | 44 | Yes |
| Bradley Specialty Corporation | 1 | \$1.1 | 18 | Yes |
| Bremen Glas Inc. | 2 | \$16.0 | 145 | Yes |
| Bristol Fiberlight Industries | 1 | \$16.0 | 160 | Yes |
| Builders Marble Inc. | 1 | \$1.0 | 35 | Yes |
| Bulk Molding Compounds Inc. | 1 | \$15.0 | 45 | Yes |
| C & K Plastics Inc. | 1 | \$1.5 | 20 | Yes |
| Cambridge Industries | 1 | \$346.0 | 3,831 | No |
| Canadian Pacific Ltd | 2 | \$9,560.0 | 33,600 | No |
| Capital Marble Creations | 1 | \$1.7 | 40 | Yes |
| Capon Valley Marble Inc. | 1 | \$5.2 | 50 | Yes |
| Carolina Counters | 1 | \$0.8 | 12 | Yes |
| Carsonite Intl. Corporation | 1 | \$17.0 | 120 | Yes |
| CDR Systems Corporation | 3 | \$38.0 | 200 | Yes |
| Central Marble Products Inc. | 1 | \$0.5 | 12 | Yes |
| Century Marble Company Inc. | 1 | \$1.7 | 40 | Yes |
| Chance Industries, Inc. | 1 | \$50.0 | 405 | Yes |
| Charloma Fiberglass Inc. | 1 | \$5.1 | 50 | Yes |
| Clark Mfg. | 1 | \$63.0 | 300 | Yes |
| Coastal Engineered Products, Inc. | 1 | NA | NA | Yes |
| Compagnie De Saint-Gobain S.A. | 1 | \$91,384.0 | 101,094 | No |
| Composites, USA, Inc. | 1 | \$3.0 | 40 | Yes |
| Comtech Telecommunications Corporation | 1 | \$20.9 | 192 | Yes |
| Concept Plastics Inc. | 1 | \$12.0 | 250 | Yes |
| Conley Corporation | 1 | \$12.3 | 120 | Yes |
| Contemporary Products Inc. | 1 | \$6.1 | 90 | Yes |
| Continental Camper Company Inc. | 1 | \$10.9 | 95 | Yes |
| Core Materials Corporation | 1 | \$52.5 | 419 | Yes |

(continued)

**Table A-1. Summary Data for Companies Reinforced Plastic Composite Facilities
(continued)**

| Company Name | Facilities (#) | Sales (\$10⁶) | Employment | Small Business |
|---|---------------------------|-------------------------------------|-------------------|---------------------------|
| Covermaster Inc. | 1 | \$2.8 | 26 | Yes |
| CR/LP Limited Partnership | 4 | \$86.0 | 1,182 | No |
| Crane Corporation | 4 | \$1,847.7 | 10,000 | No |
| Creative Pultrusions, Inc. | 2 | \$1.8 | 270 | Yes |
| Cultured Marble Products Ltd. | 1 | \$1.0 | 13 | Yes |
| Custom Fibreglass Mfg. Company | 1 | \$18.0 | 150 | Yes |
| Custom Fiberglass Moldings, Inc. | 1 | \$0.8 | 26 | Yes |
| Custom Marble Inc. | 1 | \$1.0 | 29 | Yes |
| Cytec Industries | 1 | \$1,290.6 | 5,200 | No |
| Dasco Pro, Inc. | 1 | \$7.9 | 70 | Yes |
| Delta Fiberglass & Environmental Products | 1 | \$7.5 | 50 | Yes |
| Delta Fiberglass Structures | 1 | \$9.3 | 90 | Yes |
| Denali Inc. | 3 | \$71.1 | 743 | No |
| Diamond Coach Corporation | 1 | \$10.0 | 100 | Yes |
| Diamond Fiberglass Fabricators, Inc. | 1 | \$12.0 | 85 | Yes |
| Dixie-Pacific Manufacturing Company | 1 | \$27.0 | 250 | Yes |
| Dom-Fab, Inc. | 1 | \$6.4 | 50 | Yes |
| Dow Chemical | 1 | \$20,018.0 | 40,289 | No |
| Dyson-Kissner-Moran Corporation | 1 | \$500.0 | 4,500 | No |
| Eagle Craft Inc. | 1 | \$1.8 | 26 | Yes |
| Eagle-Picher Industries Inc. | 3 | \$848.5 | 7,500 | No |
| Ebonite International | 1 | \$16.0 | 250 | Yes |
| Eckler Industries | 1 | \$12.0 | 110 | Yes |
| Ed Industries, Inc. | 1 | \$5.6 | 60 | Yes |
| Electric-Glass Inc. | 1 | \$2.7 | 27 | Yes |
| Eljer Industries | 2 | \$397.4 | 3,700 | No |
| Elmore Industries | 1 | \$1.2 | 12 | Yes |

(continued)

**Table A-1. Summary Data for Companies Reinforced Plastic Composite Facilities
(continued)**

| Company Name | Facilities (#) | Sales (\$10⁶) | Employment | Small Business |
|------------------------------------|---------------------------|-------------------------------------|-------------------|---------------------------|
| Emsig Mfg. Corporation | 1 | \$25.0 | 300 | Yes |
| Enuro Fiberglass Systems, Inc. | 3 | \$35.0 | 1,500 | No |
| Epoch Industries | 1 | \$6.4 | 50 | Yes |
| Escalade Inc. | 1 | \$93.2 | 700 | No |
| Essef Corporation | 1 | \$306.1 | 2,100 | No |
| Esterline Technologies Corporation | 1 | \$391.0 | 3,360 | No |
| E-T-M Ents. Inc. | 1 | \$24.0 | 400 | Yes |
| Evans Industries | 1 | \$42.0 | 400 | Yes |
| Evelands Inc. | 1 | \$2.4 | 15 | Yes |
| Faball USA, LLC | 1 | \$7.3 | 50 | Yes |
| Falcon Building Products | 1 | \$633.2 | 4,100 | No |
| Fedders Corporation | 1 | \$314.1 | 2,700 | No |
| FG Products, Inc. | 1 | \$7.0 | 55 | Yes |
| Fiber Pad, Inc. | 1 | \$2.9 | 49 | Yes |
| Fiber Pro | 1 | \$2.0 | 15 | Yes |
| Fibercast Company | 1 | \$22.7 | 200 | Yes |
| Fiberdome Inc. | 1 | \$3.2 | 60 | Yes |
| Fiberflex Inc. | 1 | \$6.2 | 80 | Yes |
| Fiberglass & Plastic Fab, Inc. | 1 | \$1.0 | 20 | Yes |
| Fiberglass Engineering Corporation | 1 | \$42.0 | 420 | Yes |
| Fiberglass Forms Inc. | 1 | \$1.5 | 25 | Yes |
| Fiberglass Industries Inc. | 1 | \$5.1 | 50 | Yes |
| Fiberglass Plus Recreational | 1 | \$0.7 | 10 | Yes |
| Fiberglass Products, Inc. | 1 | \$2.8 | 35 | Yes |
| Fiberglass Specialties Inc. | 1 | \$4.6 | 80 | Yes |
| Fiberglass Systems | 1 | \$5.0 | 80 | Yes |
| Celstar Group, The | 1 | \$20.0 | 180 | Yes |

(continued)

**Table A-1. Summary Data for Companies Reinforced Plastic Composite Facilities
(continued)**

| Company Name | Facilities (#) | Sales (\$10⁶) | Employment | Small Business |
|--------------------------------|---------------------------|-------------------------------------|-------------------|---------------------------|
| Fibre Body Industries, Inc. | 1 | \$12.7 | 120 | Yes |
| Fibrenetics Inc. | 1 | \$1.0 | 14 | Yes |
| Fibrex Corporation | 1 | \$30.0 | 250 | Yes |
| Fleetwood Enterprises, Inc. | 2 | \$2,874.4 | 18,000 | No |
| Florida Line of Astatula Inc. | 1 | \$1.9 | 24 | Yes |
| For Better Living, Inc. | 1 | \$81.5 | 522 | No |
| Foremost Interiors Inc. | 1 | \$1.4 | 26 | Yes |
| Formica Corporation | 1 | \$338.0 | 3,284 | No |
| Fowler Mfg. Inc. | 1 | \$6.1 | 50 | Yes |
| G. W. Fiberglass Inc. | 1 | \$38.1 | 375 | Yes |
| Gencorp Inc. | 2 | \$1,568.0 | 9,460 | No |
| General Electric Company | 1 | \$90,840.0 | 276,000 | No |
| General Motors Corporation | 1 | \$164,000.0 | 647,000 | No |
| Gesmar Corporation | 1 | \$4.1 | 50 | Yes |
| GHM Inc. | 1 | \$1.0 | 50 | Yes |
| Gibbon Fiberglass | 1 | \$1.2 | 18 | Yes |
| Glas Master Inc. | 2 | \$5.5 | 50 | Yes |
| Glasforms Inc. | 2 | \$11.0 | 110 | Yes |
| Glasgo Plastics Inc. | 1 | \$15.0 | 35 | Yes |
| Global Glass Inc. | 1 | \$8.2 | 90 | Yes |
| Goodyear Tire & Rubber Company | 1 | \$13,155.0 | 95,302 | No |
| Gorman-Rupp Company | 1 | \$150.8 | 960 | No |
| Gould Inc. | 1 | \$157.4 | 1,500 | No |
| GPI Corporation | 1 | NA | NA | Yes |
| Gpm Industries, Inc. | 1 | \$6.3 | 50 | Yes |
| Grayson Tool Company | 1 | \$2.5 | 35 | Yes |
| Gruber Sys. Inc. | 1 | \$20.0 | 160 | Yes |

(continued)

**Table A-1. Summary Data for Companies Reinforced Plastic Composite Facilities
(continued)**

| Company Name | Facilities (#) | Sales (\$10 ⁶) | Employment | Small Business |
|---|-------------------|-------------------------------|------------|-------------------|
| H & R Ind. Inc. | 1 | \$5.7 | 45 | Yes |
| Harsco Corporation | 1 | \$1,629.0 | 14,200 | No |
| Hartzell Fan Inc. | 1 | \$38.0 | 250 | Yes |
| Hasbrouck Plastics Inc. | 1 | \$1.3 | 10 | Yes |
| Hella North America Ltd | 1 | \$68.7 | 550 | No |
| Hemco Corporation | 1 | \$3.0 | 30 | Yes |
| Henderson, Black and Green, Inc. | 1 | \$17.5 | NA | Yes |
| Heritage Marble of Ohio Inc. | 1 | \$2.4 | 25 | Yes |
| Hess Company Ind. Inc. | 1 | \$18.4 | 175 | Yes |
| Hood Manufacturing | 1 | \$2.5 | 40 | Yes |
| Hydro Systems, Inc. | 1 | \$8.0 | 70 | Yes |
| Hy-Tec Fiberglass Inc. | 1 | \$1.0 | 12 | Yes |
| I. M. Pena, Inc. | 1 | \$1.4 | 15 | Yes |
| Images Products Corp | 1 | \$5.7 | 50 | Yes |
| Imco Reinforced Plastics Inc. | 1 | \$4.6 | 50 | Yes |
| Industrial Dielectrics Inc. | 1 | \$50.0 | 250 | Yes |
| Industrial Fiberglass Specialties | 1 | \$7.0 | 28 | Yes |
| Industrial Linings Inc. | 1 | \$1.7 | 30 | Yes |
| International Grating Inc. | 1 | \$4.5 | 44 | Yes |
| International Marble And Granite Supply | 1 | \$8.0 | 15 | Yes |
| International Paper | 2 | \$20,143.0 | 87,000 | No |
| North American Filtration Inc. | 1 | \$3.0 | 50 | Yes |
| Iten Ind. | 1 | \$27.2 | 250 | Yes |
| Jason Ind. Inc. | 1 | \$9.0 | 125 | Yes |
| Jason International | 1 | \$5.7 | 50 | Yes |
| Johnson Truck Bodies | 1 | \$31.0 | 270 | Yes |
| Jones Plastic And Engineering Corporation | 1 | \$98.6 | 1,310 | No |

(continued)

**Table A-1. Summary Data for Companies Reinforced Plastic Composite Facilities
(continued)**

| Company Name | Facilities (#) | Sales (\$10 ⁶) | Employment | Small Business |
|----------------------------------|-------------------|-------------------------------|------------|-------------------|
| K2 Inc. | 1 | \$302.7 | 4,600 | No |
| Keller Products, Inc. | 1 | \$37.0 | 350 | Yes |
| Kerrico Corporation | 1 | \$2.0 | 10 | Yes |
| Kivett's Inc. | 1 | \$6.2 | 100 | Yes |
| Kobe Steel Ltd. | 2 | \$1,533.5 | 13,437 | No |
| Kohler Company | 2 | \$155.6 | 1,800 | No |
| Kreider Mfg. Inc. | 1 | \$2.6 | 40 | Yes |
| Krueger International Inc. | 1 | \$345.0 | 3,000 | No |
| Laminated Products, Inc. | 1 | \$12.2 | 150 | Yes |
| Larson Company | 1 | NA | NA | Yes |
| GLNV Holdings | 1 | \$21.9 | 205 | Yes |
| Lawrence Wittman & Company, Inc. | 1 | \$6.4 | 50 | Yes |
| Leer Inc. | 2 | \$70.0 | 500 | Yes |
| Lehigh Cultured Marble Inc. | 1 | \$5.2 | 50 | Yes |
| Leucadia National Corporation | 3 | \$5,193.9 | 3,919 | No |
| Liberty Polyglas Inc. | 1 | \$5.0 | 50 | Yes |
| Lippert Corporation | 1 | \$8.0 | 100 | Yes |
| LI Cultured Marble | 1 | \$2.6 | 30 | Yes |
| Louisville Tile Distributors | 1 | \$12.0 | 150 | Yes |
| Lund International Holding Inc. | 1 | \$46.4 | 267 | Yes |
| M. C. Gill Corporation | 1 | \$39.0 | 195 | Yes |
| Mac Molding Company Inc. | 1 | \$4.3 | 75 | Yes |
| Magnum Moldings | 1 | \$0.5 | 9 | Yes |
| Marbelite Corporation | 1 | \$3.4 | 40 | Yes |
| Marble Creations | 1 | \$2.0 | 35 | Yes |
| Marble Designs Inc. | 1 | \$1.3 | 19 | Yes |
| Marble Works | 1 | \$1.0 | 16 | Yes |

(continued)

**Table A-1. Summary Data for Companies Reinforced Plastic Composite Facilities
(continued)**

| Company Name | Facilities (#) | Sales (\$10⁶) | Employment | Small Business |
|--------------------------------------|---------------------------|-------------------------------------|-------------------|---------------------------|
| Marblecast Products Inc. | 1 | \$2.1 | 35 | Yes |
| Marmon Group | 1 | \$6,100.0 | 30,000 | No |
| Masco Corporation | 2 | \$2,927.0 | 20,500 | No |
| McClarin Plastics Inc. | 1 | \$13.5 | 98 | Yes |
| McClure Ind. Inc. | 1 | \$1.0 | 11 | Yes |
| Melcher Mfg. Company Inc. | 1 | \$1.7 | 17 | Yes |
| Menasha Corporation | 2 | \$915.0 | 5,500 | No |
| Mesa Fiberglass, Inc. | 1 | \$3.0 | 32 | Yes |
| Mesa Fully Formed Inc. | 1 | \$13.5 | 220 | Yes |
| Michiana Fiberglass Inc. | 1 | \$4.9 | 50 | Yes |
| Micro-Fab Inc. | 1 | \$2.0 | 30 | Yes |
| Miles Fiberglass & Plastics | 1 | \$6.0 | 70 | Yes |
| Millennium Products Inc. | 1 | \$19.1 | 175 | Yes |
| Mincey Marble Mfg. Inc. | 1 | \$4.8 | 105 | Yes |
| Miracle Recreation Equipment Company | 1 | \$50.0 | 300 | Yes |
| Molded Fiber Glass Company | 6 | \$60.0 | 900 | No |
| Monaco Coach Corporation | 1 | \$441.9 | 2,400 | No |
| Monarch Ltd | 1 | \$9.0 | 87 | Yes |
| Morrison Molded Fiber Glass | 3 | \$100.0 | 900 | No |
| Mr. Tubs Inc. | 1 | \$9.9 | 85 | Yes |
| Murphy Body Company | 1 | \$24.0 | 135 | Yes |
| National Fiber Glass Products | 1 | \$9.3 | 80 | Yes |
| New England Plastic Coated Products | 1 | \$7.5 | 80 | Yes |
| New York Blower Company (The) | 1 | \$82.0 | 700 | Yes |
| Newport Laminates | 1 | \$2.0 | 40 | Yes |
| Niagara Fiberglass Inc. | 1 | \$2.4 | 45 | Yes |

(continued)

**Table A-1. Summary Data for Companies Reinforced Plastic Composite Facilities
(continued)**

| Company Name | Facilities (#) | Sales (\$10 ⁶) | Employment | Small Business |
|--|-------------------|-------------------------------|------------|-------------------|
| Non Metallic Resources, Inc. | 1 | \$4.7 | 40 | Yes |
| Nordic Fiberglass Inc. | 2 | \$6.9 | 111 | Yes |
| Northwest Bodies Inc. | 1 | \$5.0 | 75 | Yes |
| Nova Group, Inc. | 1 | \$54.0 | 50 | Yes |
| Nova Marble Products | 1 | \$6.4 | 40 | Yes |
| Oasis Industries | 1 | \$5.0 | 75 | Yes |
| Odom Fiberglass Inc. | 1 | \$1.1 | 20 | Yes |
| Olympic Fiberglass Ind. Inc. | 1 | \$3.9 | NA | Yes |
| Omega Polymer Technologies | 1 | \$49.1 | 380 | Yes |
| Osborne Ind. Inc. | 1 | \$12.0 | 140 | Yes |
| Owens-Corning | 5 | \$4,373.0 | 18,100 | No |
| Oxford Cmp, Inc. | 1 | \$2.8 | 55 | Yes |
| P & J Partnership | 1 | \$4.5 | 92 | Yes |
| Pacific Tank Limited | 1 | \$0.9 | 15 | Yes |
| Parkson Corporation | 1 | \$50.0 | 160 | Yes |
| Parthenon Marble Products, Inc. | 1 | \$1.7 | 30 | Yes |
| Pearl Baths Inc. | 1 | \$15.0 | 90 | Yes |
| Perma Grain Products, Inc. | 1 | \$22.0 | 200 | Yes |
| Peterson Prods. | 1 | \$6.0 | 49 | Yes |
| Phil Carter System, Inc. (The) | 1 | \$5.1 | 50 | Yes |
| Phillips Electronics North America Corporation | 1 | \$7,000.0 | 30,000 | No |
| PI US Holdings Inc | 1 | \$6.6 | 50 | Yes |
| Picken's Plastics Inc. | 1 | \$5.5 | 68 | Yes |
| Piedmont Composites | 1 | \$22.2 | 175 | Yes |
| Piedmont Fiberglass | 1 | \$0.7 | 15 | Yes |
| Pillings F.R.P. | 1 | \$3.7 | NA | Yes |
| Pinta's Cultured Marble Inc. | 1 | \$1.3 | 25 | Yes |
| Plas/Steel Prods. | 1 | \$17.5 | 300 | Yes |

(continued)

**Table A-1. Summary Data for Companies Reinforced Plastic Composite Facilities
(continued)**

| Company Name | Facilities (#) | Sales (\$10⁶) | Employment | Small Business |
|------------------------------------|---------------------------|-------------------------------------|-------------------|---------------------------|
| Plas-Tech, Ltd. | 1 | \$12.7 | 100 | Yes |
| Plastic Composites Corporation | 1 | \$2.8 | 45 | Yes |
| Plastic Development Company | 1 | \$5.0 | 50 | Yes |
| Plasti-Fab | 1 | \$3.3 | 42 | Yes |
| Poly Foam International | 1 | \$37.4 | 542 | No |
| Polymer Concrete Corporation | 1 | \$1.4 | 16 | Yes |
| Polyply, Inc. | 1 | \$2.0 | 25 | Yes |
| Premix, Inc. | 2 | \$124.0 | 520 | No |
| Prestigious Accessories Inc. | 1 | \$11.1 | 54 | Yes |
| Primero, Inc. | 1 | \$1.3 | 20 | Yes |
| Prodelin Corporation | 1 | \$50.0 | 250 | Yes |
| Prototype Concepts Inc. | 1 | \$2.7 | 50 | Yes |
| R & D Marble Inc. | 1 | \$2.5 | 53 | Yes |
| R V National Holdings | 1 | \$137.1 | 1,387 | No |
| Radiant Marble Company | 1 | \$5.2 | 50 | Yes |
| Raven Industries, Inc. | 3 | \$120.4 | 1,368 | No |
| Red Ewald Inc. | 1 | \$7.0 | 100 | Yes |
| Retterbush Injection Molded | 1 | \$1.3 | 20 | Yes |
| Robroy Industries, Inc. | 2 | \$130.0 | 1,000 | No |
| Rockwell International Corporation | 2 | \$7,762.0 | 45,000 | No |
| Rocor Transportation Cos. | 1 | \$60.0 | 650 | No |
| Roma Marble Inc. | 1 | \$1.8 | 27 | Yes |
| RPM Inc | 1 | \$1,350.5 | 6,651 | No |
| Rubber & Plastic Applicators | 1 | \$1.7 | 30 | Yes |
| Rynone Mfg. Corporation | 1 | \$9.1 | 200 | Yes |
| Ryobi North America | 1 | \$600.0 | 3,800 | No |
| S. R. Smith, Inc. | 1 | \$14.9 | 120 | Yes |

(continued)

**Table A-1. Summary Data for Companies Reinforced Plastic Composite Facilities
(continued)**

| Company Name | Facilities (#) | Sales (\$10⁶) | Employment | Small Business |
|-------------------------------------|---------------------------|-------------------------------------|-------------------|---------------------------|
| Schmitt Marble Prods. Inc. | 1 | \$2.5 | 50 | Yes |
| Scm Container Machinery Ltd | 1 | \$208,152.0 | 2,399 | No |
| Seal Reinforced Fiberglass | 1 | \$1.6 | 19 | Yes |
| Seymour Manufacturing Company Inc. | 1 | \$22.0 | 160 | Yes |
| Shenandoah Fiberglass Prods. | 1 | \$2.0 | 26 | Yes |
| Sherman Utility Structures, Inc. | 1 | \$110.9 | 875 | No |
| SMC Corporation | 1 | \$200.8 | 1,400 | No |
| Southeast Marble Inc. | 1 | \$2.2 | 35 | Yes |
| Space Tables | 1 | \$2.5 | 12 | Yes |
| Spears Manufacturing | 1 | \$89.0 | 875 | No |
| Specialty Plastics Associates, Inc. | 1 | \$3.9 | 53 | Yes |
| Specialty Plastics, Inc. | 1 | \$3.0 | 65 | Yes |
| Square D Company | 2 | \$1,856.0 | 16,000 | No |
| St. Croix of Park Falls Ltd. | 1 | \$12.0 | 130 | Yes |
| St. Mary's Marble, L.L.C. | 1 | \$4.3 | 65 | Yes |
| Standard Glas, Inc. | 1 | \$1.8 | 15 | Yes |
| Sunrise Fiberglass Corporation | 1 | \$2.5 | 30 | Yes |
| Sunset Plastics Inc. | 1 | \$3.0 | 35 | Yes |
| Superior Home Prods. Inc. | 1 | \$35.0 | 175 | Yes |
| Syn-Mar, Inc. | 1 | \$0.7 | 12 | Yes |
| Takara Belmont Usa | 1 | \$42.0 | 98 | Yes |
| Taylor Ind. Inc. | 1 | \$1.8 | 17 | Yes |
| Teco Inc. | 1 | \$22.0 | 180 | Yes |
| Tecton Products | 1 | \$2.0 | 20 | Yes |
| The Alpha Corporation | 1 | \$150.0 | 325 | Yes |

(continued)

**Table A-1. Summary Data for Companies Reinforced Plastic Composite Facilities
(continued)**

| Company Name | Facilities (#) | Sales (\$10⁶) | Employment | Small Business |
|-------------------------------------|---------------------------|-------------------------------------|-------------------|---------------------------|
| Thyssen Ag | 4 | \$40,753.4 | 127,873 | No |
| Tiffany Marble Mfg. Inc. | 1 | \$1.0 | 21 | Yes |
| Tom Smith Fiberglass Inc. | 1 | \$0.7 | 9 | Yes |
| Tompkins Ind. Inc. | 9 | \$1,400.0 | 14,000 | No |
| Trail Wagons Inc. | 1 | \$3.8 | 50 | Yes |
| Tri City Marble | 1 | \$5.0 | 15 | Yes |
| Trinity Industries | 1 | \$2,234.7 | 16,300 | No |
| TRW Inc. | 1 | \$1,000.0 | 79,700 | No |
| U.S. Fiberglass Prods. Inc. | 1 | \$10.3 | 50 | Yes |
| Ultra/Glas of Lakeville Inc. | 1 | \$1.5 | 15 | Yes |
| United States Marble Inc. | 1 | \$4.0 | 40 | Yes |
| United Technologies Corporation | 1 | \$22,802.0 | 170,600 | No |
| Universal Plastics Inc. | 1 | \$3.4 | 55 | Yes |
| Vendura Industries, Inc. | 1 | \$1.5 | 24 | Yes |
| Venetian Marble | 2 | \$0.8 | 20 | Yes |
| Vertex Plastics Inc. | 1 | \$2.3 | 19 | Yes |
| Viatec, Inc. | 2 | \$16.0 | 150 | Yes |
| VMC Fiberglass Products, Inc. | 1 | \$14.0 | 250 | Yes |
| W. H. Brady Company | 2 | \$426.1 | 2,500 | No |
| Walnut Investigation Company | 1 | \$6.3 | 50 | Yes |
| Warminster Fiberglass Company | 2 | \$7.0 | 100 | Yes |
| Wayne Mfg Company | 1 | \$6.0 | 150 | Yes |
| Werner Ladder Company | 1 | \$253.1 | 2,700 | No |
| Western Recreational Vehicles, Inc. | 1 | \$20.0 | 400 | Yes |
| Wexco, Inc. | 1 | \$46.1 | 275 | Yes |
| William Kreysler & Associates, Inc. | 1 | \$2.0 | 20 | Yes |
| Wilson Marble Company | 1 | \$0.8 | 20 | Yes |

(continued)

**Table A-1. Summary Data for Companies Reinforced Plastic Composite Facilities
(continued)**

| Company Name | Facilities (#) | Sales (\$10 ⁶) | Employment | Small Business |
|------------------------------|-------------------|-------------------------------|------------|-------------------|
| Xenon Company, Inc. | 1 | \$1.0 | 9 | Yes |
| Xeres | 6 | \$54.0 | 493 | Yes |
| Yankee Plastic Company | 1 | \$0.8 | 8 | Yes |
| Zane's Fiberglass Shop, Inc. | 1 | \$5.7 | 50 | Yes |
| Zehrco Plastics, Inc. | 2 | \$20.1 | 190 | Yes |
| | 433 | \$763,429.6 | 2,126,586 | 278 |

NA = not available

Sources: American Business Information (ABI). 1999. American Business Disc [computer file].
 Disclosure Inc. 1998. Worldscope [computer file]. Bethesda, MD: Disclosure Inc..
 Dun & Bradstreet. 1998. Dun's Market Identifiers [computer file]. New York, NY: Dialog Corporation.
 Dun & Bradstreet. 1999. *Million Dollar Directory: America's Leading Public and Private Companies*. Bethlehem, PA: Dun & Bradstreet Corporation.
 Gale Research, Inc. 1998. *Ward's Business Directory of U.S. Private and Public Companies*. Detroit, MI. Gale Research, Inc.
 Gale Research, Inc. 1996. *Manufacturing USA*. Detroit, MI. Gale Research, Inc.
 Information Access Corporation. 1998. Business & Company ProFile [computer file]. Foster City, CA: Information Access Corporation.
 Selected Company 10-K Reports.

Appendix B

Economic Model of the Merchant Sector of the U.S. Reinforced Plastic Composites Industry

Implementation of the proposed NESHAP will affect the costs of production in the U.S. RPC industry for producers that use thermoset resins. Responses at the facility level to these additional costs collectively determine the market impacts of the regulation. Specifically, the cost of the regulation may induce some facilities to alter their current level of production or even to close. These choices affect, and in turn are affected by, the market price for each product. The economic impact analysis employs standard concepts in microeconomics to model the supply of each product and the impacts of the regulation on production costs and the output decisions of merchant facilities.¹ The main elements of the analysis are as follows:

- characterize production of each product at the individual facility and market levels,
- characterize demand for each product, and
- develop the solution algorithm to determine the with-regulation equilibrium.

The following sections provide the supply and demand specifications for each product market as implemented in the EIA model and summarize the model's solution algorithm.

B.1 Supply of Reinforced Plastics Products

Cost curves were constructed for each product line at existing RPC facilities using thermosetting resins. Facilities using thermoplastic resins are not subject to the proposed regulations and are treated as an aggregate producer. Therefore, for a particular end-use market, the market supply of RPCs can be expressed as

$$Q^s = q^D + q^I. \quad (\text{B.1})$$

where q^D is the supply from directly affected thermosetting facilities and q^I is the supply from indirectly affected thermosetting and thermoplastic facilities.

B.1.1 Thermosetting Facilities (q^D) (Directly Affected)

Existing merchant producers of RPCs have the ability to vary output in the face of production cost changes. Economic theory provides the rationale for believing that supply functions for existing suppliers are upward sloping. For this analysis, the generalized Leontief technology is assumed to characterize the production of RPCs at each facility. This technology is appropriate given the fixed-proportion material inputs (resins, filler, and

¹ As noted in Section 4, the impact of the regulation on captive producers is determined through a full-cost absorption approach that does not incorporate market changes and results in profits being reduced by the estimated compliance costs for these producers.

reinforcements) and the primary variable-proportion inputs of labor and energy. Applying Hotelling's lemma to the generalized Leontief profit function produced the following general form of the supply function for each RPC product line:

$$q_j = \gamma_j + \frac{\beta}{2} \left[\frac{1}{p} \right]^{\frac{1}{2}} \quad (\text{B.2})$$

where p is the market price for the reinforced plastic product, γ_j and β are model parameters, and j indexes producers (i.e., individual existing facilities). The theoretical restrictions on the model parameters that ensure upward-sloping supply curves are $\gamma_j > 0$ and $\beta < 0$.

Figure B-1 illustrates the theoretical supply function of Eq. (B.2). As shown, the upward-sloping supply curve is specified over a productive range with a lower bound of zero that corresponds with a shutdown price equal to $\frac{\beta^2}{4\gamma_j^2}$ and an upper bound given by the productive capacity of q_j^M that is approximated by the parameter γ_j . The curvature of the supply function is determined by the β parameter.

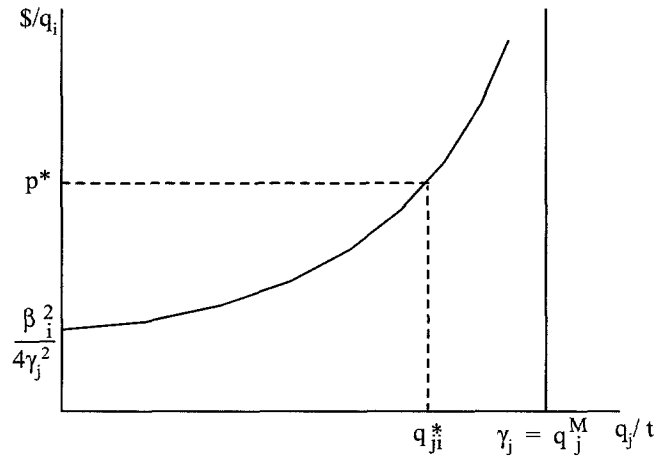


Figure B-1. Theoretical Supply Function for Existing Facilities

To specify the supply function of Eq. (B.2) for this analysis, the β parameter is computed by substituting an assumed market supply elasticity, (ξ) , for a particular reinforced

plastic product, the market price of the product (p), and the production-weighted average annual production level of existing facilities (q) into the following equation:²

$$\beta = -\xi 4q \left[\frac{1}{p} \right]^{-\frac{1}{2}} \quad (\text{B.3})$$

Absent literature estimates, the market-level supply elasticities were assumed to be 1 (unitary elasticity) (i.e., a 1 percent change in price leads to a 1 percent change in output). The 1997 market prices of each product were derived as described in Section 4, and the average annual production level of each product for each facility was derived from the facility database. The β parameter for each product was calculated by incorporating these values into Eq. (B.3).

The parameter, γ_j , approximates the productive capacity and varies across product lines at each facility. This parameter does not influence the facility's production responsiveness to price changes as does the β parameter. Thus, the parameter γ_j was used to calibrate the model so that each existing facility's supply equation is consistent with the baseline production data.

Production decisions at the individual facilities are affected by the total annual variable compliance costs, c_j , which are expressed per pound of reinforced plastics product. Each supply equation will be directly affected by these regulatory control costs, which enter as a net price change (i.e., $p_j - c_j$). Thus, with the regulation the supply function for each existing facility from Eq. (B.2) above becomes:

$$q_j^e = \gamma_j + \frac{\beta}{2} \left[\frac{1}{p_j - c_j} \right]^{\frac{1}{2}} \quad (\text{B.4})$$

The total annual variable compliance costs per pound are projected given the annual production per facility and the regulatory cost estimates for each facility provided by the engineering analysis.

² Equation B.3 is determined by 1) taking the derivative of the supply function (B.2) with respect to price, 2) multiplying the expression by p/q to yield a term for the supply elasticity, and 3) solve the resulting equation for the β parameter.

In evaluating the impacts of the proposed rule, we shift the individual supply curves by the variable portion of the compliance costs and then evaluate the closure decision with the total compliance costs (fixed, or annual capital, costs plus variable costs associated with new production level). Therefore, our modeling approach addresses the economic viability of the product-line and evaluates whether it continues to cover variable costs with regulation as well as the economic viability of the plant and evaluates whether it continues to cover total costs (variable plus fixed) with regulation.

In order to evaluate the economic viability of the plant, the Agency determined baseline estimates of variable and fixed production costs. As noted above, applying the supply function specification to each directly affected producer generates an estimate of production, or variable, costs by taking the integral of the area under the curve corresponding to their production rate and market price. Lacking direct information from each facility, to approximate plant-level fixed costs, the Agency applied an industry average profit rate of 4.4 percent for each facility.³ Thus, fixed costs at each facility i were then derived as:

$$\text{Fixed Costs}_i = \text{Sales}_i - \text{Variable Costs}_i - \text{Profits}_i$$

where $\text{Profits}_i = 4.4\% * \text{Sales}_i$. Given this baseline characterization of each facility, the Agency evaluated their economic viability with regulation and predicted a facility closures if profits were not positive, i.e., total revenues did not exceed total production costs and total regulatory costs.

B.1.2 Thermosetting and Thermoplastic Facilities (q^I) (Indirectly Affected)

Because this industry segment is not directly affected by the regulation it was not necessary to model their supply at an individual facility level as was necessary for directly affected thermosetting facilities. EPA specified a single representative function to express the supply of RPCs from indirectly affected facilities, which allows them to increase their production in response to higher prices, i.e.,

$$q^I = A^I [p]^{\epsilon^I} \quad (\text{B.5})$$

³ As applied for this analysis, this rate reflects the maximum profit rate for an individual facility, i.e., a threshold level of profitability. Those facilities whose total revenue minus production costs resulted in a return of less than 4.4 percent of revenues used the lower rate for determination of economic viability or regulation induced closure.

where q^I is the quantity supplied from indirectly unaffected facilities, A^I is a positive constant, and ξ^I is the supply elasticity. Absent literature or econometric estimates, the supply elasticity was assumed to have a value of one. The multiplicative supply parameter, A^I , is determined for each product by back solving Eq. (B.5) given the supply elasticity and baseline values for the market price and quantity supplied in each market segment.

The resulting RPC products from these facilities are modeled as perfect substitutes for RPC products from thermosetting facilities. Therefore, they supply at the same price for each end-use market which serves to dampen the ability of the directly affected producers to increase prices in response to regulation. Although it may be more appropriate to model as imperfect substitutes with cross-price elasticities, the Agency did not have sufficient information to provide those model parameters and chose an option that would be a worst-case scenario for affected industry segment (i.e., conservative modeling approach).

B.2 Demand for Reinforced Plastics Products

A single equation expresses the demand for each reinforced plastic composites product,

$$Q^D = B^D [p]^{\eta^D} \quad (B.6)$$

where Q^D is the quantity demanded, B^D is a positive constant, and η^D is the demand elasticity. Absent literature or econometric estimates, the demand elasticity was assumed to have a value of -0.5 . The multiplicative demand parameter, B^D , was determined for each product by back solving Eq. (B.6) given the demand elasticity and baseline values for the market price and quantity demanded in each market segment.

B.3 With-Regulation Market Equilibrium Determination

Facility responses and market adjustments can be conceptualized as an interactive process. Facilities face increased production costs due to compliance, which causes facility-specific production responses (i.e., output reduction). The cumulative effect of these responses leads to an increase in the market price that all producers (directly and indirectly affected) and consumers face, which leads to further responses by producers (directly and indirectly affected) as well as consumers and thus new market prices, and so on. The new equilibrium after imposing the regulation is the result of a series of iterations between producer and consumer responses and market adjustments until a stable market price arises where total market supply equals total market demand, that is $Q^S = Q^D$.

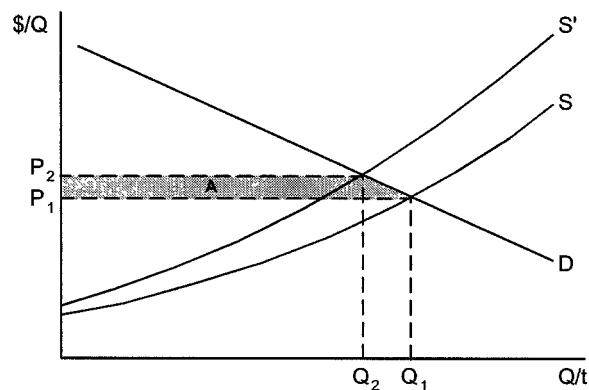
The algorithm for deriving the post-compliance equilibria in all markets can be generalized to five recursive steps:

- 1) Impose the control costs on each affected facility, thereby shifting inward their supply curve and reducing their production level at the given market price.
- 2) Recalculate the market supply of each reinforced plastic product by horizontal summation across all suppliers.
- 3) Determine the new prices for all product markets.
- 4) Recalculate the supply functions of all facilities with the new prices, resulting in a new market supply of each product. Evaluate market demand at the new prices.
- 5) Go to Step 3, resulting in new prices for each product. Repeat until equilibrium conditions are satisfied in all markets.

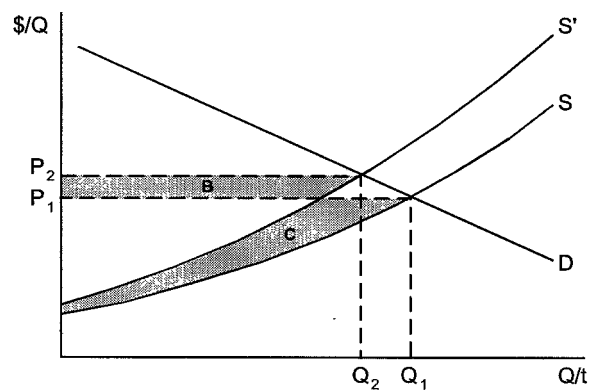
B.4 Economic Welfare Impacts

The economic welfare implications of the market price and output changes with the regulation can be examined using two slightly different tactics, each giving a somewhat different insight but the same implications: changes in the net benefits of consumers and producers based on the price changes and changes in the total benefits and costs of these products based on the quantity changes. This analysis focuses on the first measure—the changes in the net benefits of consumers and producers. Figure B-2 depicts the change in economic welfare by first measuring the change in consumer surplus and then the change in producer surplus. In essence, the demand and supply curves previously used as predictive devices are now being used as a valuation tool.

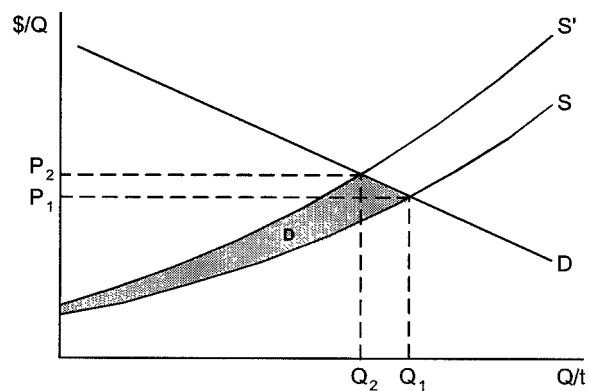
This method of estimating the change in economic welfare with the regulation divides society into consumers and producers. In a market environment, consumers and producers of the good or service derive welfare from a market transaction. The difference between the maximum price consumers are willing to pay for a good and the price they actually pay is referred to as “consumer surplus.” Consumer surplus is measured as the area under the demand curve and above the price of the product. Similarly, the difference between the minimum price producers are willing to accept for a good and the price they actually receive is referred to as “producer surplus” or profits. Producer surplus is measured as the area above the supply curve and below the price of the product. These areas can be thought of as consumers’ net benefits of consumption and producers’ net benefits of production, respectively.



(a) Change in Consumer Surplus with Regulation



(b) Change in Producer Surplus with Regulation



(c) Net Change in Economic Welfare with Regulation

Figure B-2. Economic Welfare Changes with Regulation: Consumer and Producer Surplus

In Figure B-2, baseline equilibrium occurs at the intersection of the demand curve, D , and supply curve, S . Price is P_1 with quantity Q_1 . The increased cost of production with the regulation will cause the market supply curve to shift upward to S' . The new equilibrium price of the product is P_2 . With a higher price for the product, there is less consumer welfare, all else being unchanged as real incomes are reduced. In Figure B-2(a), area A represents the dollar value of the annual net loss in consumers' benefits with the increased price. The rectangular portion represents the loss in consumer surplus on the quantity still consumed, Q_2 , while the triangular area represents the foregone surplus resulting from the reduced quantity consumed, $Q_1 - Q_2$.

In addition to the changes in consumer welfare, producer welfare also changes with the regulation. With the increase in market price, producers receive higher revenues on the quantity still purchased, Q_2 . In Figure B-2(b), area B represents the increase in revenues due to this increase in price. The difference in the area under the supply curve up to the original market price, area C, measures the loss in producer surplus, which includes the loss associated with the quantity no longer produced. The net change in producer welfare is represented by area $B - C$.

The change in economic welfare attributable to the compliance costs of the regulation is the sum of consumer and producer surplus changes, that is, $-(A) + (B - C)$. Figure B-2(c) shows the net (negative) change in economic welfare associated with the regulation as area D. However, this analysis does not include the benefits that occur outside the market (i.e., the value of the reduced levels of air pollution with the regulation). Including this benefit may reduce the net cost of the regulation or even make it positive.

| TECHNICAL REPORT DATA <i>(Please read Instructions on reverse before completing)</i> | | |
|--|--|---|
| 1. REPORT NO. EPA-452/R-00-007 | 2. | 3. RECIPIENT'S ACCESSION NO. |
| 4. TITLE AND SUBTITLE Economic Impact Analysis of Proposed Reinforced Plastics NESHAP | | 5. REPORT DATE May 2001 |
| | | 6. PERFORMING ORGANIZATION CODE |
| 7. AUTHOR(S) Tayler H. Bingham, Brooks M. Depro, and Mark C. Buckley RTI | | 8. PERFORMING ORGANIZATION REPORT NO. RTI Project Number 7647-140 |
| 9. PERFORMING ORGANIZATION NAME AND ADDRESS Research Triangle Institute (RTI) Center for Economics Research, Hobbs Bldg. Research Triangle Park, NC 27709 | | 10. PROGRAM ELEMENT NO. |
| | | 11. CONTRACT/GRANT NO. 68-D-99-024 |
| 12. SPONSORING AGENCY NAME AND ADDRESS John Seitz, Director Office of Air Quality Planning and Standards Office of Air and Radiation U.S. Environmental Protection Agency Research Triangle Park, NC 27711 | | 13. TYPE OF REPORT AND PERIOD COVERED Final |
| | | 14. SPONSORING AGENCY CODE EPA/200/04 |
| 15. SUPPLEMENTARY NOTES | | |
| 16. ABSTRACT <p>This report evaluates the economic impacts of the proposed NESHAP for reinforced plastics manufacturing. The industry impact and social costs of the rule are estimated by incorporating the expected costs of compliance to a partial equilibrium model of the U.S. industry and projecting the market impacts for the various end-use markets. The report also provides the initial regulatory flexibility analysis (IRFA) that evaluates small business impacts.</p> | | |
| 17. KEY WORDS AND DOCUMENT ANALYSIS | | |
| a. DESCRIPTORS | b. IDENTIFIERS/OPEN ENDED TERMS | c. COSATI Field/Group |
| economic impacts small business impacts social costs | Air Pollution control Economic Impact Analysis Regulatory Flexibility Analysis | |
| 18. DISTRIBUTION STATEMENT Release Unlimited | 19. SECURITY CLASS (Report) Unclassified | 21. NO. OF PAGES |
| | 20. SECURITY CLASS (Page) Unclassified | 22. PRICE |